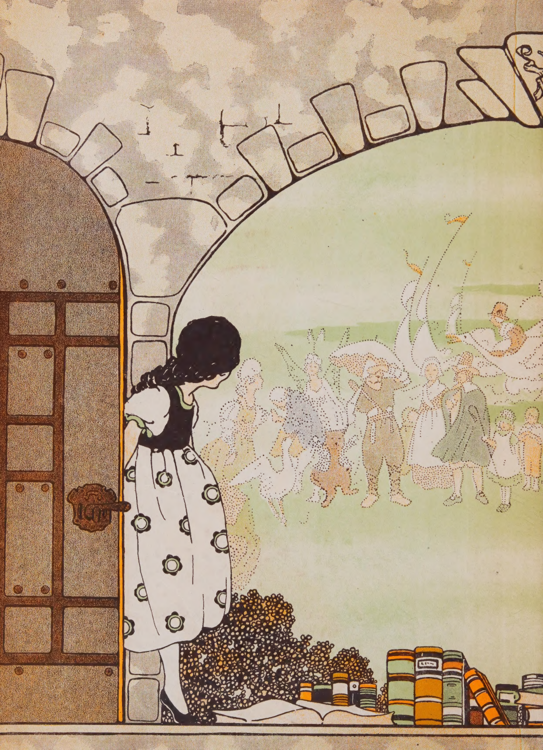

Hilda Hanway

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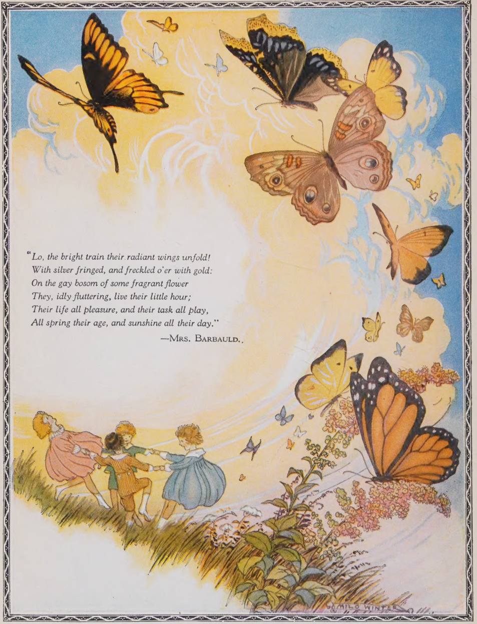
Nature Study

OH! WHAT a joy to be a child or a butterfly on a happy day of sunshine and merry winds! While a bee is all busyness because there is so much to do putting away honey for the winter, the butterflies haven't a care in the world. Nobody to look after but themselves, living on an occasional sip of nectar, they spend the livelong day flitting and drifting about in the golden air.

It is the "wondrous sculptured dust," the scales on their wings, that breaks up the rays of sunlight falling upon them and produces all the beautiful colors and shadings of butterflies and moths. But how a gaudy butterfly, like the Kallima of India, ever got put together so that the moment he settles on a twig and folds his gay wings he looks like an old withered leaf—that nobody knows. Possibly you may be the very boy or girl to find out some day. Many Nature secrets quite as mysterious have been solved by men of science who began by amusing themselves with Nature's puzzle pages just as you are doing this very minute.

(See Page 3846)

NATURE STUDY AMONG THE BUTTERFLIES



"Lo, the bright train their radiant wings unfold!
With silver fringed, and freckled o'er with gold:
On the gay bosom of some fragrant flower
They, idly fluttering, live their little hour;
Their life all pleasure, and their task all play,
All spring their age, and sunshine all their day."

—Mrs. Barbauld.

Leading the merry air dance in his swallowtail coat is Papilio asterias, the common eastern "Swallowtail." The Papilio genus is known as the "Swallowtail" because almost all its members dress as formally as this handsome fellow. The gay ball clothes of the big butterfly just behind him, Vanessa antiopa, show beneath the "mourning cloak" from which he gets his popular name. Just back of him is Mr. Clouded Sulphur, the common "Puddle Butterfly." Madam Clouded Sulphur is sitting out this dance on a nodding flower-spike below with the handsome "Monarch" (Anosia plexippus), one of the "Milkweed Butterflies." Perhaps you did not know, often as you have seen the yellow wings of the clouded sulphur or common "puddle butterfly" gilding the cloverfields and moist places of the roadside, that it answers to the stately name of Colias philodice. Terias nicippe is the brownish butterfly with browner bordered wings, hovering over the head of the "Monarch." Just between Terias and half eclipsing the Clouded Sulphur with one of his splendid jeweled wings is the Buckeye Butterfly (Junonia caenia), one of the "Peacock Butterflies."

COMPTON'S PICTURED ENCYCLOPEDIA

VOLUME 9

To inspire ambition, to stimulate the imagination, to provide the inquiring mind with accurate information told in an interesting style, and thus lead into broader fields of knowledge—such is the purpose of this work

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HERE AND THERE in Volume Nine

AT ODD TIMES when you are just looking for "something interesting to read," without any special plan in mind, this list will help you. Divided as it is into broad groups, it offers a fascinating variety of subjects for selection. With this as a guide, you may wander through storyland, visit far-away countries, meet famous people of ancient and modern times, review history's most brilliant incidents, explore the marvels of nature and science, play games—in short, find whatever suits your fancy of the moment. This list contains, however, only a small proportion of the articles in this one volume, and is not intended to serve as a table of contents, an index, or a study-guide. For these purposes consult the Fact-Index and the Study Outlines at the end of this work.

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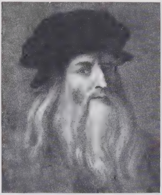
KEY TO PRONUNCIATION

Pronunciations have been indicated in the body of this work only for words which present special difficulties. For the pronunciation of other words, consult the Fact-Index in the last volume. Marked letters are sounded as in the following words: *cāpe, ăt, fär, fȧst, swạt, fa̤ll; mē, yĕt, fẽrn, thêre; īce, bĭt; rōw, nŏt, fôr, wȯn, do̤; cūre, bŭt, düne* (French *u*), *rṳde, fụll, bûrn; ḡo, ġem, cañyon, Jeaṅ,* (nasal); G = German *g* (guttural); K = German *ch* (guttural).

LEONARDO DA VINCI, *a Giant among Giants*

VINCI (*vĭn′chē*), **LEONARDO DA** (1452–1519). Three great Italians—Michelangelo, the master of power and strength in all the arts, Raphael, master of beauty and harmony in painting, and Leonardo da Vinci, master of thought and feeling—embodied the Renaissance at its height, before it degenerated from creative power to mere imitation of the classic manner.



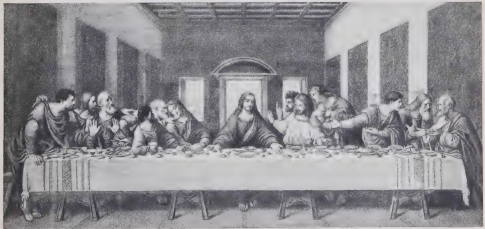
LEONARDO DA VINCI

Of the three, Leonardo da Vinci reached farthest into the future, for he stood for more than a mastery of art. In the realms of mathematics, science, and engineering his mind was one of the keenest the world has ever known. Curiosity and the love of the uncommon were the ruling passions of his life and led him into investigations that touched many lines of learning as well as art.

He was a universal genius who made important investigations in the field of geology, geography, and astronomy; he painted pictures which are universally hailed as unsurpassed even in that age of giants; and he planned great engineering works to control the courses of the Arno and the Po rivers, and perfected many practical inventions. He glimpsed secrets of nature that were not revealed till hundreds of years later. It is said he even designed and made the model of a heavier-than-air flying machine that, judged by the account in his manuscripts, needed only an efficient motor to make it practical.

No single man could have carried out a hundredth part of what Leonardo planned. Realizing the reception given too advanced ideas, he took the precaution to write his manuscripts from right to left, instead of left to right. This makes his many notes and memoranda seem illegible to one who does not possess the key; so they lay almost unheeded until the present day.

The personal charm of young Leonardo was in keeping with his brilliant mind. As he went about the streets of Florence in his rose-colored cloak, his golden hair falling about his shoulders, his sketch book hanging from his waist, he was a striking contrast to the crowd that followed him. Old and young hung on his words as he held them with jest, song, or story so that he might study the varying expressions of their faces. In the market place he bought caged birds for the joy of setting them free; or matching his strength with some strolling ragamuffin's, would bend a horseshoe as easily as if it were a strip of lead.



Da Vinci's 'Last Supper', which is by common consent placed among the twelve great paintings of all time, represents the dramatic moment when Christ has uttered the words: "One of you shall betray me." The disciples have started into attitudes indicating their consternation, some leaping to their feet, others still sitting.

Leonardo served his artist's apprenticeship as the favorite pupil of Verrocchio, a skilled goldsmith, sculptor, and painter of Florence, who was particularly distinguished as a teacher. When 20 years of age he became a member of the painters' guild, and for the next ten years he practiced his art in Florence, in the golden days of Lorenzo the Magnificent of the house of Medici. Much of his later life was spent in Milan in the service of the usurping duke, Ludovico il Moro, or in that of Caesar Borgia, of unsavory fame, while his last years were passed in France in the employ of King Francis I, where he died in 1519.

A Painter of the Emotions

Unlike most of the great masters, Leonardo da Vinci left few finished works. Yet he is one of the best known among the great men of the world, and it is chiefly as an artist that he is remembered. He made great changes in the technique of painting, for to him light and shade were as important as color to other artists. But the quality that makes Da Vinci's art unique is his ability to put into the faces on his canvas the intangible expression of hidden emotion.

Two paintings by Da Vinci are among the greatest masterpieces of the world—the 'Mona Lisa', a portrait in oils, and 'The Last Supper', a large wall painting on plaster in "distemper" (colors mixed with a water-soluble medium). The 'Mona Lisa' (also called 'La Gioconda') is probably the most celebrated portrait picture in the world. Against a fantastic background of rocks and water, Leonardo painted a face that has been the theme of endless discussions. The picture of this Florentine lady of Neapolitan birth has today lost the wonderful red of the lips and the rose-like quality of the skin, but the shimmer of the eyes, the subtle enigmatic smile playing about the mouth, the wonderful hands, are almost unspoiled by the lapse of years. This picture, the pride of the Louvre museum in Paris, was stolen from its gallery in 1911; but two years later it was found in the possession of an Italian in Florence, and was restored to its French resting place.

The Famous 'Last Supper'

The 'Last Supper' was painted on the refectory wall of the convent Church of Santa Maria delle Grazie at Milan. The disciples, with the Master in their midst, are represented at one side of a table, their faces to the spectator. The words, "One of you shall betray me," have just been spoken, and the picture shows in the expressions of the hearers the varied effects of the announcement. The furnishings of the chamber are very simple; no decorative figures have been added, the background is a wall with three windows through which, at a distance, a landscape is seen. There is nothing to detract from the dramatic interest of the situation. For a time this world-famous picture, because of the manner in which the colors were applied to the wall, and because of the neglect to which it was subjected, was almost reduced to ruin. At the beginning of the 20th century, however, it was skilfully restored to something of its original splendor.

Da Vinci as a sculptor must be judged from report only. The great equestrian statue he designed and modeled as a monument for the house of Sforza in Milan was never executed. For three years the colossal plaster model 26 feet high stood in the courtyard of Castello, exciting admiration and extravagant praise from all who saw it. The great task of casting the monument in bronze was barely under way when Ludovico il Moro was overthrown by the French. The great statue then became the target of Gascon archers and was soon destroyed. From the report of contemporaries and from sketches left by the artist it would seem that this statue, if completed, would have rivaled any equestrian statue in the world.

VINEGAR. "Sour wine" is the meaning of the word vinegar, and sour wine is what one variety of vinegar is. Wine vinegar is made by exposing fermented grape juice to the air until the alcohol has been changed into acetic acid. In the United States much vinegar is made similarly from fermented apple juice, or cider, but a malt vinegar is also made from fermented malt. Cider vinegar is preferred in the United States.

The characteristic sharp sour taste is given by the acetic acid, which is usually present in the proportion of four to eight per cent. The various colors and flavors depend on the kind of liquid from which it is made. You have often seen a sort of gelatinous scum in the vinegar bottle. This is the "mother of vinegar," or ferment which changes the alcohol into acetic acid.

The process of fermentation is usually hastened in the commercial manufacture by pouring the alcoholic liquid into a cask or vat filled with purified beech-wood shavings, which have been soaked in strong vinegar. As the liquid soaks down through the shavings it is rapidly fermented, since large surfaces are thus exposed to the air. The liquor that filters through is poured in at the top again and again, until practically all the alcohol has been changed into acetic acid. Home-made vinegar is often produced by putting the vinegar plant into a weak solution of sugar or molasses.

There are Federal laws establishing standards for the various vinegars. It is very easy and cheap to use a little dilute sulphuric acid and color the product to look like vinegar, and this was often done before the enactment of the United States pure food laws. Vinegar should never be kept in metal vessels, because acetic acid reacts with the metal and "eats" it away. It forms lead acetate, a poison, if there is any lead present. (*See* Fermentation.)

VIOLET. Snuggled beneath a blanket of fallen leaves in cool woods the modest little violet sleeps until spring. Then it awakes and we find, in place of a blanket of leaves, a covering of such flowers that—

> One might guess
> A storm of blossoms had fallen there
> And covered the ground with a sweet excess.

The common blue violet is found wild in woodlands, meadows, and marsh from Nova Scotia to Minnesota and southward to Georgia and Kansas, during April, May, and June. Other species, such as the roundleaved violet, the sweet white violet, and the Canada violet, also grow wild. The familiar pansy is a cultivated form of a European species of violet (*see* Pansy). The sweet violet (*Viola odorata*) is the parent of the varieties which are grown in greenhouses and rank among the most important commercial flowers. The dog's-tooth violet, or adder's tongue, is not a violet at all, but is a member of the lily family.

So dear to the hearts of everyone is the modest little violet that several states have adopted it as their floral emblem. Napoleon was fond of it, and in Paris the statues commemorating the loss of Alsace-Lorraine were decorated annually with violets.

Scientific name of common blue violet, *Viola cucullata*. Flowers solitary on scapes, 5 unequal petals, and 5 sepals extended into ears at the base. Leaves large, dark green, heart-shaped, growing on petioles.

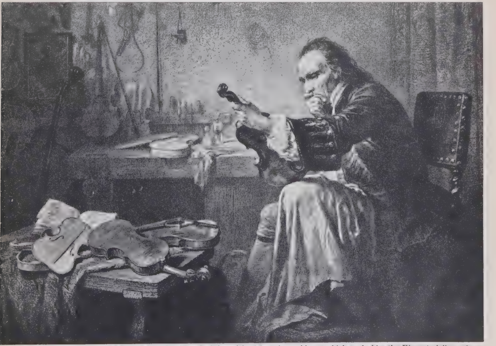
The STRINGS *that Sing with* HUMAN TONES

The Most Sympathetic of All Musical Instruments, the Violin—Only After Long and Loving Association with Human Beings Does It Utter Its Richest, Tenderest Notes

VIOLIN. For sweetness and richness of tone, the violin has no rival among musical instruments. The harp, piano, and organ can produce more varied effects, but a violin in the hands of a master player can be made to "sing" as can nothing else but the human voice. The violin seems almost human, too, in the complexity and delicacy of its structure, and in the fact that age and use are required to mellow it and bring it to perfection. The best artists agree that no new violin, even the most perfectly made, will produce as rich and full a tone as one that has been used for 30 or 40 years. That is why old instruments made by master artists are worth many times their weight in gold. A price of $10,000 is not at all unusual.

The violin is a shell of wood. Across a bridge on its upper side are stretched four strings made from the dried intestines of the sheep or goat. At either side of the strings are sound holes, which permit the air inside the sound box to vibrate. The tone is produced by the vibrations of these strings when they are set in motion by the friction of the violin bow. The beauty of the tone is due not alone to the strings, but also to the

THE GREAT VIOLIN MAKER IN HIS WORK SHOP



As we look at the grave studious face of Stradivari, we feel the spirit of devotion to his art which made him the King of violin-makers. The tools that you see, with which he wrought such marvels, were bequeathed to him by his beloved master, Amati.

delicate shell-body against which the air vibrates after the strings have set it in motion. After the first violin was made, men worked more than a hundred years before they finally perfected this wonderful little sound-box.

The forerunners of the violin came from the mysterious East. According to tradition, the first stringed instrument played with a bow was invented by a king of Ceylon about 5000 B.C.; and wandering minstrels in India to this day play a strange looking two-stringed fiddle, said to be virtually the same instrument as the one of which the legend tells. The Arabs had a one-stringed fiddle, called the "rebek," which found its way to Europe some time before the 10th century of our era. Later drawings and sculptures of the Middle Ages show similar instruments with variously shaped bodies, and two, three, or more strings.

From this crude instrument of the viol family developed the violin and its larger cousins. As its Italian name shows us, the violin was perfected in Italy, where it took approximately the form we have today, in the latter half of the 16th century.

Andreas Amati, and His Priceless Handiwork

Its chief home was Cremona, a little town near Venice. Here the celebrated Andreas Amati grew up, and to him the most important thing in life was to make a perfect violin. He knew that the fineness of the tone depended on the fineness of the body, and that for a fine body he must have the finest quality of wood. So he experimented with wood from all the trees that grew in that sunny land. It is beautiful to read how those who worked with him were as interested as he himself in the task he set out to accomplish. They not only found the finest wood but also discovered wonderful methods of finishing it. The violins made by Amati from 1554 to 1580, and by his nephew and pupil, Nicolo Amati, are now almost priceless treasures.

Of all the masters of that old Cremona school, the name that stands highest is that of Antonio Stradivari, who was first a pupil, then a master there. As a boy, he studied and worked and experimented, as the Amatis had done. His special contribution was to make all the curves and arches of the violin body most delicate, and yet strong and resonant. He chose, for this quality, the wood of a certain pine that grew on the hillsides near the town. He then experimented with the oils and different finishes until he created a varnish that gave the body the rich color of amber. The secret of this perfect varnish seems to have been lost, for since the days of Stradivari, no such violins have been made. It almost seems as if his great devotion to his task were in some way ingrained into the very fiber of the material he used. It is said that he was grave, gentle, and dignified, slow of speech and of manner, except when his beloved violins were concerned; then he was swift as lightning, and exacting into the smallest detail. In the later years of his life he would not allow his name to be signed to the instruments he made, fearing that his failing eyesight might have permitted the slightest flaw to pass unnoticed. More than 1,000 violins, violas, and 'cellos still exist bearing the master's name, most of them made between 1690 and 1730. Hundreds of spurious instruments have also been constructed in exact imitation, even to the label.

Of the other masters who wrought at Cremona the greatest was Giuseppe Antonio Guarneri (known as Guarneri del Gesu), a member of another celebrated family of violin-makers. Some of his work was inferior, but the best of it is considered by some to equal that of Stradivari.

How the Violin is "Taught" to Sing

About seventy pieces of wood go to the making of a violin. The wood must be chosen, seasoned, and shaped with the greatest care, so it will not warp. It is held together only by glue. For the "belly," as the top of the sounding-box is called, pine and silver fir are used almost entirely, because of their great elasticity. Maple is generally used for the back, sides, bridge, and neck. The richness of tone depends on the mathematical exactness with which the proportions are distributed, and the size and positions of the curiously shaped sound-holes. Horse-hair is used for the bow, because each hair has many minute bristles pointing away from the root. It is these minute bristles that give the bow its "bite," thus setting the violin strings in vibration. From 175 to 250 hairs are laid side by side, half pointing in one direction and half in the other.

The violin has remained virtually unchanged in shape or substance for three centuries. In that time the harpsichord, lute, and spinet have passed away, the harp has been improved, the piano has been invented and developed. But the violin, which took a hundred years to assume its form, remains today what it became in the days of the great Stradivari.

In the same family with the violin are also the *viola*, an instrument of the same shape and about one-fifth larger than the violin; the *violoncello*, of the same shape, but so much larger that it rests on the floor and is held between the knees of the seated player; and the *double bass*, whose deep voice is the bass of the whole orchestra. The instruments of this group are often referred to as "the strings," and they are really the backbone of the orchestra, outnumbering all the other instruments put together.

VIPERS. From man's point of view the vipers are perhaps the most objectionable of all snakes, for their title to leadership in the serpent family rests upon the exquisite perfection of their poison apparatus. They are usually divided into two groups called the "true vipers" and the "pit vipers." The latter group, which includes the rattlesnake, the copperhead, and the water-moccasin, is distinguished by a deep cavity or pit between the eye and the nose. This pit is lined with highly sensitized skin, but its purpose is unknown.

The cobras and a few other snakes possess a poison more powerful than that of the vipers, but the latter have jaws and fangs far better suited to injecting their deadly venom deep into the flesh of their victims.

Their fangs are longer, and, instead of the deep groove on the front side, as in the cobras, a tube or canal leads from the poison glands through the tooth itself to a spot near the sharp tip. Unlike other poisonous snakes, also, the vipers are able to erect that part of their upper jaw which holds the fangs, thus bringing these weapons into more dangerous prominence.

Among the best known of the 40 or more species of "true vipers" are the following: the common viper, adder, or *kreuzotter* of Europe, whose bite is not as a rule fatal; the sand viper, which bears a fleshy horn upon its nose; the puff-adder of northern Africa, which inflates its body and hisses loudly when approached; the horned viper, also of northern Africa, which has a horny spike over each eye and which is believed to have caused the death of Cleopatra; and the "daboia" or Russell's viper, which is the largest and most poisonous of the group, reaching a length of five feet, and which is one of the scourges of India and neighboring countries. With the exception of one African genus, all vipers bring forth living young. No true vipers are found in America, which is essentially the home of the pit vipers, of which there are about 60 species, all of them highly poisonous. (*See* Snakes).

VIREO. The Latin word *vireo* means "I am green," but the birds of this family are so in name only, for their coloration is chiefly plain olive, whitish, or buff-yellow, with only sometimes green, yellow, or blue on the head. They are small, active, tree-living birds, about 70 species of them, found only in America, especially in the tropical regions.

Though eating some fruit, vireos (or "greenlets," as they are also called) are mainly insectivorous, finding their food amid the foliage of shrubs and trees. Most of the species have an oft-repeated musical call that places them among the class of singing birds, though the three- or four-note phrases can hardly be called a song. The nesting habits of the various species are similar. The small, cup-shaped, semi-hanging nest is secured to a forked tree branch and finely wrought of mosses, lichens, and fibers. The white eggs are spotted and from three to five in number.

The red-eyed vireo, common throughout the United States except in the arid districts, is well known because of its persistent call which, with its manner of sitting in plain sight as if demanding a hearing, has given it the nickname of "preacher-bird." (For illustration in colors *see* Birds.) The white-eyed vireo, found in southwestern United States and Mexico, is an always clever and amusing character of birdland. Its call has been variously translated; "whip-Tom-Kelly" is the most popular word equivalent. The blue-headed vireo has a cap of slate-gray and is found in the forests of eastern America. Its appetite for caterpillars has won for it the title of "conservator of the forests."

Scientific name of red-eyed vireo, *Vireo olivaceus;* of white-eyed vireo, *Vireo griseus;* of blue-headed vireo, *Vireo solitarius.*

The "OLD DOMINION" — *Mother of Presidents*

VIRGINIA. Soaking in Atlantic brine from latitude 38° to 39° 30′ is a knotted fringe of peninsulas, each great tassel in turn fraying out into lesser peninsulas. This is tidewater Virginia, flat and in places swampy, the fringe on the robe of the "Mother of Presidents."

Extent.—North to south, greatest distance, about 200 miles; east to west, 440 miles. Area, 42,627 square miles. Population (1920 census), 2,309,187.

Physical Features.—Coastal plain crossed by many rivers and bordered by an island-fringed coast; Piedmont region rising to the Blue Ridge in the west (Mt. Rogers, 5,719 feet); Great Valley of Virginia lying between the Blue Ridge and the Alleghenies which form the western boundary; Great Dismal Swamp in the southeast; Luray Cavern and Natural Bridge in the Great Valley. Principal rivers: Potomac, Rappahannock, York, James, and Staunton.

Products.—Corn, wheat, hay, tobacco, peanuts, apples, vegetables; cattle, horses, hogs; shellfish; coal, clay, stone, and iron; lumber and timber; iron and steel manufactures, railroad cars, tobacco products, textiles, leather and leather goods, flour and meal.

Chief Cities.—Richmond (capital, population about 175,000), Norfolk (116,000), Portsmouth (55,000), Roanoke (52,000).

The branching bays which make the Virginia coast a "sylvan Venice" are in fact, geologists tell us, "drowned river valleys." They testify to a time when the present lands, now barely lifted above sea-level, stood much higher than at present. The spill of the coast eastward into the Atlantic left the Dismal Swamp region (with Lake Drummond the center) covered with fresh water, made all the important streams navigable part way, and created in Hampton Roads one of the finest harbors along the Atlantic coast of the United States.

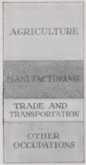
A Private Seaport for Every Plantation

Curiously enough, this very accessibility of tidewater Virginia was one factor which hindered its commercial development. The early plantations bordered on navigable water, and each, as a rule, had its own wharf where seagoing vessels might load. Any planter might become a trader on his own account, and some did, but only in a small way, for the profits on this scattered trade were not great enough to induce them to forsake the easy gains of tobacco-raising. Thus there was no encouragement to the growth of a merchant class; towns and markets had no territory from which to draw trade until the back country was settled, and not only New York but also Boston, Philadelphia, and Baltimore grew into important ports while Norfolk and its splendid harbor were passed by.

Back of tidewater, the Virginia portion of the great coastal plain rises gently to an elevation of 150 to 300 feet. This, settled next after tidewater, was the region of vast baronial estates in colonial days.

Next westward comes the Piedmont belt, where spurs and broken ranges of the Blue Ridge run out into the gently rolling plain, as lower down the peninsulas project into the ocean. These spurs are separated, not by bays, but by innumerable valleys of all forms, which here and there spread out into plains. This was the extreme frontier of "Ole Virginny" until the middle of the 18th century, peopled not by wealthy planters and their slaves, but by hardy pioneer farmers, the first frontiersmen.

Higher up again are the ranges of the Blue Ridge Mountains, running from northeast to southwest, and widening toward the south. The early colonists believed them impassable, and the first explorers to ascend the ridge turned back discouraged at the sight of yet other ranges looming up no less formidably to the west; which apparently only goes to show that there were no seasoned mountaineers among the early settlers, for Virginia mountains, though majestic and beautiful, are comfortable, approachable giants with well cushioned bones—not gaunt and forbidding like some even of the more southern Appalachians. The highest point, Mount Rogers, is 5,719 feet above sea-level.

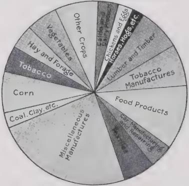


How the chief occupations of the people compare in Virginia.

West of the Blue Ridge is the valley of Virginia, which is the central portion of the greater Appalachian valley. As the great peninsulas of the coast are seamed by rivers into minor peninsulas, so the Great Valley is seamed by lesser ridges into the minor valleys of the Shenandoah, the James, the Roanoke, the New, and the Holston rivers. This region, which Washington predicted would become "the garden of America," is the most fertile portion of Virginia. Yet, because it was comparatively inaccessible from the southeast, it was settled largely by immigrants of German and Scotch-Irish stock who pushed down the valley from Pennsylvania. West of this again are the long crumpled ridges of the newer Appalachians.

Interesting features of the whole region west of the coastal plain are the numerous mineral springs, some of which, like Hot Springs, White Sulphur Springs, and Sweet Chalybeate Springs, have become fashionable resorts. The limestone region of the Great Valley, in addition, abounds in caverns (Luray and the Grottoes of the Shenandoah are among the most remarkable and beautiful), natural bridges (the most magnificent is known by that name alone), and "lost" or underground rivers.

PRODUCTS OF VIRGINIA



The state's recent industrial progress is shown by the high proportion of manufactures.

Although the abundant local pride of Virginia does not seem to center around its rivers—perhaps there are too many of them—they have had an important influence on the development of the people. Five-sixths of the state is drained by five navigable streams, the Potomac, the Rappahannock, the York, the James, and the Roanoke or Staunton. While these, in colonial days, brought London to the planter's front door, so to speak, they and their tributaries also isolated him from his next-door neighbor, for there were few bridges or ferries. From this circumstance and from the great size of the plantations grew up the tendency for each estate to be a self-supporting unit. So persistent was the habit that not until 20 or 30 years after the Civil War, it is said, was there a bank or postal money order or express office in all rural tidewater Virginia.

Naturally, the New England town meeting, with its direct control of local affairs by close neighbors, would not work here. There were no local affairs except the affairs of the plantations, whose boundaries were often as wide as the old parish. In Virginia today, therefore, the smallest administrative unit is the county, not the township.

Virginians are perhaps more definitely a type than the citizens of any other state. Only an insignificant fraction of the population are foreign-born. Your typical Virginian counts many generations of Virginia forefathers; he is proud not only of being a son of the Old Dominion, but of cousinship with almost every other F. F. V. ("First Family of Virginia"). A great city where no one stops to say "Howdy?" is more uncongenial to him than the North Pole. Of course, even Virginia "co'n pone" and beaten biscuit are "different." Yet Virginians are very far indeed from being provincial, and their recent agricultural and industrial history proves how progressive they are.

Although the early history of the state was, so to speak, written on tobacco leaves, tobacco is no longer the leading crop; corn, potatoes, and forage crops usually exceed it in value. Nor is Virginia the leading tobacco-raising state; Kentucky and North Carolina have surpassed it since 1900. A very fortunate thing for Virginia was this agricultural revolution. Not only did King Tobacco tax the land so exorbitantly as to exhaust it; he was a jealous tyrant who prevented the development of other resources.

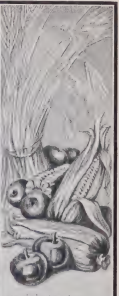
Now Virginia boasts of being one of the great truck-growing states in the Union and one of the greatest peanut-growing states; both industries center around Norfolk. Many parts of the valley of Virginia are vast apple orchards. The Albemarle pippin, now a popular variety, originated here.

The fisheries, especially the oyster fisheries, are important. The Lynnhaven Bay oyster is said to be

WHY THE "OLD DOMINION" IS BUSY AND PROSPEROUS

A Star Peanut Producer

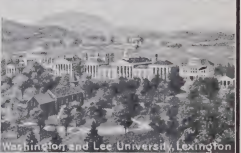
A Great Garden Truck State


Virginia Leaders—Wheat, Corn, and Apples

Tobacco Products a Chief Manufacture

Large Production of Soft Coal

The Capitol, Richmond


Washington and Lee University, Lexington

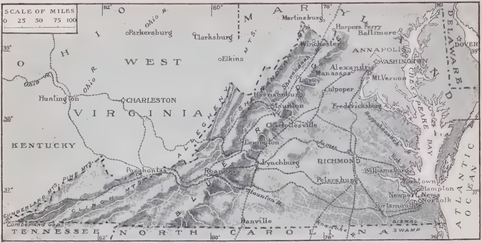
Important Leather and Shoe Center

Her Blue Grass Grows Wealth on the Hoof

Valuable Hardwoods

In the early days of Virginia, tobacco-raising was the chief occupation, and the state led in the production of this crop until after the Civil War. Now corn and hay are more important, and dozens of small crops, including the lowly peanut, fruits of many kinds, and garden truck of every kind make a varied farm output. Tobacco products and a variety of lumber products are the leading manufactures, but chemicals and fertilizers are of growing value. More than one-half of the state is wooded, and coal and iron are abundant in the western part. The live-stock industry is flourishing, Virginia's pedigreed horses and cattle being famous throughout the United States. The Capitol at Richmond is a fine example of dignified Colonial architecture. Washington and Lee University at Lexington, founded in 1749, owed its first development to a gift of $50,000 from George Washington. Its growth and influence were greatly extended while Gen. Robert E. Lee was its president, 1865–1870.

THE MOUNTAINS, VALLEYS, AND COASTLINE OF VIRGINIA


SCALE OF MILES
0 25 50 75 100
82°
80°
78°
76°
39°
38°
37°
OHIO
Ohio R.
Parkersburg
Clarksburg
Elkins
WEST VIRGINIA
Huntington
CHARLESTON
KENTUCKY
Pocahontas
PINE MTS.
CUMBERLAND MTS.
CLINCH MTS.
Cumberland Gap
TENNESSEE
NORTH CAROLINA
MARYLAND
Martinsburg
Harpers Ferry
Baltimore
ANNAPOLIS
WASHINGTON
DOVER
DELAWARE
Winchester
SHENANDOAH MTS.
Shenandoah R.
ALLEGHENY MTS.
BLUE RIDGE
Alexandria
Manassas
Mt.Vernon
Luray
Culpeper
Harrisonburg
Staunton
Fredericksburg
Potomac R.
Rappahannock R.
CHESAPEAKE BAY
Charlottesville
Lexington
James R.
Lynchburg
RICHMOND
York R.
Williamsburg
Yorktown
Hampton
Newport News
Norfolk
Portsmouth
Roanoke
Petersburg
Staunton R.
Danville
Roanoke R.
DISMAL SWAMP
ATLANTIC OCEAN

A triple row of mountains outlines Virginia's western border, and pours down a network of streams across the lowlands to the sea. The broken coast with its many fine harbors has always been an important factor in developing the wealth of the state.

the largest and most delicious known. Accomac County alone produces over 75 per cent of the soft shell crabs consumed in the United States.

A Great Live Stock Region

The western portion of the state is a hay-raising and grazing section. Especially fine horses are raised in the Shenandoah Valley. Appalachian Virginia claims to be the only section of the United States which ships cattle direct from the blue-grass pasture fields to foreign ports. The Blue Ridge has more live stock per square mile than any other section.

Although the forests of the state have been steadily cut for years, considerable timber and lumber, especially hardwoods from the Blue Ridge and Appalachian regions, are still produced. The accessibility of hemlock and oak forests and the proximity of a cattle-growing section have made Lynchburg an important leather- and shoe-manufacturing center, as well as the most important inland railroad center after Richmond.

The first gold and the first coal mined in the United States came from Virginia. The gold production (all in a belt running from the Potomac to Halifax County) is still insignificant, but the coal (all in the Appalachian region) is an important factor in the state's industrial progress. The famous Pocahontas bed produces one of the most valuable grades of coking and steam coal. The Kanawha deposits are especially valuable because near great deposits of iron ore. Virginia's production of iron, important after the Revolution, declined in the middle of the 19th century, but increased again with the development of railroad facilities and the discovery of high-grade ores in the southwestern part of the state. Although Virginia's production of iron does not compare with that of the Great Lakes region, this metal is an important factor in its manufactures. Among other minerals produced are clay, soapstone, pyrites for the manufacture of sulphuric acid, and limestone, used for flux in the iron and steel industry.

The Increase in Manufactures

Although Virginia is still an agricultural state first of all (it has less than a score of towns with a population of over 5,000), manufactures have increased of late years. Among the more important products are tobacco products, flour and meal, lumber, iron and steel, railroad cars, foundry and machine-shop products, cotton goods, and leather.

The more important towns are Richmond, the capital and chief city (*see* Richmond); Norfolk, the chief port and next most important manufacturing town; Lynchburg, already mentioned as a leather-manufacturing and railroad center; Charlottesville, the seat of the University of Virginia and of woolen manufactures, besides being near neighbor to Jefferson's home, Monticello; Portsmouth, near neighbor to Norfolk and site of the "Norfolk" United States navy yards, forms a single port with Norfolk; Newport News, important port and manufacturing center, with large shipbuilding plants; and Roanoke, with large railway shops and other factories. The World War created several "boom towns" like Hopewell, which in eight months grew up in an old cornfield into a city of 27,000.

The history of Virginia from the first settlement of Jamestown in 1607 to the present is, like that of Massachusetts, the history of the nation, and is told elsewhere. On her soil the Revolution ended with the surrender of Cornwallis at Yorktown, and the Union was forever cemented when the gallant army of Lee laid down its arms at Appomattox. She has been not only a "Mother of Presidents" for Washington, Jefferson, Madison, Monroe, William Henry Harrison, Tyler, Taylor, and Woodrow Wilson were born on her soil, but a Mother of States, for the old Northwest Territory and West Virginia and Kentucky were once within her boundaries.

Her colleges and institutions of higher learning have made their contribution, too, to the life of the nation. The public school system has taken on new vigor in recent years and promises to lift Virginia nearer the head in the matter of general education. Certainly the fervent words attributed to the Virginia colonial governor, Sir William Berkeley, "I thank God there are no free schools nor printing and I hope we shall have none these hundred years," have no echo and no truth in the Old Dominion today.

VIRGINIA CREEPER. This beautiful creeping vine, often called American woodbine or American ivy, is found in nearly all parts of America, either wild or cultivated as a porch climber. It is especially attractive in autumn, when its leaves take on a vivid coloring of gold and crimson. With its strong tendrils this plant has the power of fixing itself firmly to walls and trees. The flat disks at the end of the tendrils secrete a cement-like substance so strong that a single tendril with five branches will hold up a weight of ten pounds. The Virginia creeper is often mistaken for poison ivy, but can be easily distinguished by the fact that the leaves of the former are made up of five leaflets, while the latter are three-parted.

Scientific name, *Ampelopsis quinquefolia*. Flowers yellowish green, branching clusters, insignificant. Leaf composed of 5 leaflets, glossy green, turning to bright yellow and red in autumn, elliptical, outer half coarsely toothed. Berry small, round, dark purple.

VIRGIN ISLANDS. Fifty miles east of Porto Rico lies a group of picturesque islands, forming a bow with its convex side stretching into the Atlantic Ocean and its concave side washed by the Caribbean Sea. They are the Virgin Islands of the West Indies, part belonging to the British Empire and part to the United States.

The islands of St. Croix, St. Thomas, and St. John, originally owned by Denmark, after many years' negotiations were purchased by the United States in 1916 for $25,000,000 and possession was taken in March 1917. They grow the customary West Indian fruits, vegetables, sugar-cane, and cotton; cover a combined area of 132 square miles, and have a combined population of 26,000, over 92 per cent of whom are negroes, the rest being whites or of mixed blood. St. Thomas on the island of St. Thomas is the chief port, with a population of over 8,000. Mount Bordeaux on St. John Island (1,270 feet) is the highest mountain. The importance of the islands arises largely from their location at one of the gateways to the Caribbean Sea and the Panama Canal.

The rest of the Virgin Islands belong to the British Empire. There are about 32 of these, covering a combined area of 58 square miles, with a total population of 6,000. The islands were discovered and named by Columbus on his second voyage, in 1494.

VISTULA RIVER. Like a gigantic letter "S," this river of central Europe winds its course of 650 miles from the northern slope of the Carpathian Mountains through the entire length of Poland to the sea, where it empties through several arms into the Frisches Haff and Baltic Sea.

Despite the fact that the shifting channel makes navigation difficult, and that around Warsaw the Vistula (German *Weichsel*) is ice-bound generally from December 20 to March 10, good-sized craft usually can pass up to its junction with the San, and smaller boats up to the city of Cracow. Indeed, the river has a large traffic in grain, lumber, and other products, and forms Poland's chief commercial highway. The Peace of Versailles (1919) made Danzig, at its mouth, a free city, and established a Polish "corridor" along the river to give Poland its needed outlet to the Baltic.

The Vistula, which has a drainage area of about 74,000 square miles, rises at the height of 3,600 feet above sea-level. It first flows through a mountain valley and falls 180 feet a few miles from its source. Breaking up into almost parallel arms in its lower course, the river incloses beautiful wooded islands. Because these arms keep changing their channels, and because of the amount of their discharge, they have to be carefully regulated to safeguard navigation as well as to protect the delta regions from floods. The chief tributaries of the river, which teem with fish, are the San, Bug, and Pilica. A canal connects it with the Oder.

VITAMINS (*vī'tȧ-mĭnz*). It has long been known that diet plays an important part in certain diseases such as rickets, beriberi, scurvy, and pellagra. Even in the 18th century ship captains had learned to carry a supply of fresh lemons on long voyages to prevent scurvy, the dread scourge of people long deprived of fresh foods. In the late 19th century it was found that beriberi, a serious and often fatal disease then common among the rice-eating peoples of the Far East, could be prevented by a mixed diet and even by a diet of whole instead of "polished" rice—that is, rice stripped of its bran and germ. What is generally known as the "vitamin theory" was the first satisfactory explanation of the puzzling fact that such a terrible disease as scurvy, for instance, could be caused by an apparently well-balanced ration of good food. Briefly, this theory is that certain substances, called by some "vitamins" and by others "accessory food substances," existing in minute quantities in natural foodstuffs, are necessary to life. Five vitamins are at present recognized.

"Fat-soluble A" is essential to growth and health. It also promotes resistance to infectious diseases. Growing children and animals need more of it than do adults. Cod-liver oil is especially rich in this vitamin and hence is one of the most valuable foods for infants. The livers of other fish and of food animals also contain it. It is abundant in egg-yolk, fish roe, milk, cream, butter, most animal fats (but not lard), and certain vegetables, as fresh cabbage, spinach, tomatoes, and lettuce; vegetable oils, such as olive oil, are poor in it. Long exposure to heat gradually destroys it, but ordinary cooking seems to have no important effect on it. Long storage of butter seems to diminish its supply of this vitamin.

"Water-soluble B" is the anti-beriberi vitamin; acne (pimples), boils, and pellagra have also been attributed to a deficiency of it. It is very widely distributed among foods, and is not greatly affected by ordinary cooking; hence beriberi is unknown among people who live on even a moderately varied diet. Eggs and yeast are rich in it; it is plentiful in cereals (chiefly in the germ and bran—patent flour is very poor in it); and there is a fair supply in milk and many vegetables and fruits, especially tomatoes. Young animals fed on food which lacks vitamins A and B stop growing and soon die.

"Water-soluble C" is the anti-scurvy vitamin. It is found especially in fresh fruits and vegetables. Most citrus fruits are rich in it (there is less in limes than in oranges, lemons, and grapefruit); so are fresh cabbage, spinach, raw turnip juice, potatoes, tomatoes, and rhubarb. Onions, lettuce, and sprouted grains have a good supply. Milk has only a limited amount, and that is diminished by pasteurization, at least if the milk stands for a time afterward. Hence physicians now generally recommend that artificially fed babies be given a little orange juice, tomato juice, or even raw turnip juice to prevent infantile scurvy. Water-soluble C is extremely sensitive to heat and even to drying, which explains why Arctic explorers, besieged populations, crews of ships long at sea, and other persons forced to live exclusively on even the best of dried and canned foods are subject to scurvy. Yet some anti-scurvy foods, such as oranges and (according to some authorities) tomatoes, seem to retain this vitamin after cooking or proper drying.

Vitamin D, called "the sunshine vitamin," prevents rickets and is necessary for the proper growth of bones, teeth, and muscles. It is richly present in cod-liver oil, and, to some extent, in egg-yolk, milk, coconut oil, seeds, and green leaves.

Vitamin E, found most abundantly in red meat and the germ of wheat, is necessary to fertility.

The constitution of vitamins and their exact function remain to be discovered. We do know, however, that very small amounts are sufficient for the body's needs, so that any person eating a well-balanced diet need have no fear of vitamin deficiency.

The study of these remarkable food substances is still in its infancy, and new discoveries about them are made every year. One of the interesting recent developments is the discovery that vitamin D can be produced in various foods by irradiating them with ultra-violet light. Another late development is the theory that vitamin B is composed of at least two, perhaps three, separate substances.

VLADIVOSTOK (*vlăd-ĭ-vŏs-tŏk'*), SIBERIA. Pleasing indeed to one landing from a rough trip on the choppy Sea of Japan are the green fields and gentle hill slopes that encircle the magnificent harbor of Vladivostok. This is the chief seaport of Siberia, and the eastern terminus of the Trans-Siberian Railway, 5,162 miles from Moscow and 1,243 miles farther from Leningrad than New York City is from San Francisco.

With its huge dry-docks and shipyards, its railway terminals, and the harbor crowded with shipping, Vladivostok at first glance resembles any American Pacific port. But the almost naked Chinese coolies who do its hard work, and the thousands of Japanese

RUSSIA'S GREAT GATEWAY ON THE PACIFIC

As the chief seaport of Siberia and the eastern terminus of the Trans-Siberian railway, Vladivostok occupies a place of tremendous importance in the commercial life of Russia. Here we see its hill-crowned harbor. In the foreground is the poorer quarter occupied by the fisher folk; the main part of the city lies along the slopes to the left.

and Koreans who throng its streets stamp it as of the Orient. Antiquated droskies (Russian carriages) drag painfully and slowly through its almost impassable streets, axle-deep in mud.

With large areas of northeastern Manchuria and the whole of the great Amur valley tributary to it, with its own extensive fisheries and huge timber resources, and the great iron deposits near by, Vladivostok promises to develop considerable industrial importance. The climate is severe, with an average temperature of 40° F., but the harbor is free from ice nine months of the year, and ice-breaking steamers keep it always open. During the World War of 1914–18, immense quantities of supplies were sent to Russia from the United States by way of Vladivostok. Population, about 100,000.

WHAT SHALL *I* DO *for a* LIVING?

A Fundamental Question in the Life of Every Boy and Girl—How Vocational Education Helps to Find the Answer—Its Great Scope—The Readjustment of War Cripples to Self-Helpful Life

VOCATIONAL EDUCATION. A new meaning has been given to the term "vocational education" as a result of the World War. In all countries tens and even hundreds of thousands of soldiers and sailors were crippled or otherwise permanently disabled by wounds received in that terrible conflict.

What should be done with these helpless victims? Should they be left unaided to earn their living as best they could—perhaps to become beggars on the streets? Such ingratitude to its disabled heroes was not to be dreamed of by any self-respecting country!

LEARNING TO JUDGE DAIRY COWS

This class of boys in the famous Michigan State Agricultural College is learning how to judge the points which make a cow a good milker. The ability to select the best cows is an important factor in the dairyman's success.

In the United States, as in most of the warring lands, a twofold process was established. It included the *physical reconstruction* of the wounded men, so as to restore their lost powers as far as possible; and their *vocational education*, to teach them new trades and professions, which they could follow in their maimed condition.

The marvels wrought in the military hospitals in the way of physical reconstruction make an astounding record. Modern surgery thinks nothing of giving to a war-shattered man a new nose or jawbone—at times almost an entire new face; and living tissues—flesh, bone, skin, etc.—are successfully grafted from one part of the body to another, or even from one creature to another. Equally marvelous are the mechanical arms, hands, and feet made by skilled workmen, so delicately adjusted to the remaining muscles that the fingers can be moved and the joints operated with something of the ease of the natural hand or leg. Every effort was made also to reëducate muscle and mind to prevent the patient from even thinking of himself as a maimed and useless wreck. And the work of the military hospitals was supplemented and continued by a whole host of agencies, which gave to wounded men a vocational education—that is, which taught them some useful trade or calling, fitted to their physical and mental powers, by which they could earn a decent living.

When the marvelous results obtained in the vocational education of wounded soldiers and sailors became known, the question was then asked: Why not apply the same methods to the workmen crippled in mines and factories and on railroads? So similar provision was made by a law of Congress for the vocational education of such industrial cripples.

But vocational education in its usual sense has a larger scope even than the reëducation of those crippled in war or in industry. It is a movement which concerns the able-bodied as well, and in this aspect also it has received important aid and direction from the Federal government.

There are several quite common misconceptions concerning it which should be cleared up. One of these is that it is something new; another is that it means a very narrow type of training, in a limited field. Really vocational education means much more than training boys, or even crippled adults, to be machinists, carpenters, electricians, and the like.

"Vocational education," it has been said, "is any form of education, whether given in a school or

A CLASS OF FUTURE SHIPWRIGHTS

During the World War the demand for skilled workmen in the ship-building industry was so great that classes for training them were held in hastily improvised quarters like the schoolroom shown. These men are learning their first lesson about the different parts of a ship.

elsewhere, the purpose of which is to fit an individual to pursue effectively a recognized profitable employment, whether pursued for wages or otherwise." And the dictionary defines a vocation as follows: "Destined or appropriate employment, calling, occupation, trade, business, profession." Notice that under these two definitions almost all means by which people earn their living in an honorable manner form the field of vocational education. The 1920 census of the United States lists more than 20,000 different occupations, which indicates the wide scope of vocational education.

Vocational education for ordinary persons subdivides into the following ten divisions, and there are schools already established for each occupation mentioned in each division:

1. *Industries and manufactures* (industrial education)—with all its skilled trades, such as those of the machinist, bricklayer, goldsmith, watchmaker, milliner, tailor, diamond-cutter, baker, electrician, etc.
2. *Agriculture* (agricultural education)—with its various branches of fruit-raising, dairying, stock-raising, horticulture, bee-keeping, etc.
3. *Home economics* (vocational home-making education)—as the vocation of home-making, which is in itself a composite of many occupations.
4. *The professions* (professional education)—such as medicine, law, theology, education, architecture, dentistry, surgery, and the engineering professions.
5. *The clerical occupations* (commercial education)—bookkeeping, accountancy, stenography, with the allied branches of salesmanship and advertising.
6. *The nautical trades and professions* (nautical education)—such as those of pilot, mate, purser, steward, skipper, marine engineer, etc. These occupations and schools are more numerous in the large maritime ports and nations than is realized by the general public.
7. *Mining.*—In nearly all states where mining is done to any extent the mine foremen and fire bosses have to pass an examination set by the state authorities. Schools and classes are organized for the benefit of those miners who wish to advance to the next higher grade.
8. *Transportation.*—It is only within the past few years that regularly organized schools have been started to prepare students in the various branches of transportation.
9. *Personal service.*—Schools for cooks, seamstresses, barbers, manicurists, chiropodists, etc., are quite common throughout the entire nation.
10. *Public service.*—New York City has probably the most notable examples of schools and classes especially organized for those who desire to enter public service. Civil service schools are quite numerous, as are schools and classes for policemen and firemen.

Vocational education must not be confused with vocational training. A machine operator or tender can be trained in a few hours to run one machine or perform one operation, but it takes several years to properly train a good machinist. Vocational education, or, more specifically in this case, *industrial* education, is limited at present to those occupations which contain a body of knowledge which can be taught and learned in a definite way. In other words, the type of worker that vocational education produces is the intelligent skilled mechanic, one who can not only handle his tools well and run his machine effectively, but also has a thorough understanding of the science of his trade. He knows the physics, chemistry, mathematics, drawing, etc., of his trade or occupation, and is an "educated" man in as true a sense as the man who has been given a classical course in a college.

Vocational education is not by any means a new thing. In the ancient Jewish Talmud we find the statement: "He who does not teach his son a trade prepares him to be a robber. As it is your duty to teach your son the law, teach him also a trade."

Solon, the great law giver who remodeled the government of Athens in 594 B.C., made it the duty of each father to teach his son a trade. The Athenian constitution exempted from the duty of maintaining his parents in old age those boys whose parents had not taught them a trade.

LEARNING TO MANAGE A SHIP

Of course, the ships built by the shipwrights would be useless without navigators to take charge of them; so it was necessary during the war also to set up schools to train navigators for the merchant marine. This class of men is learning to take observations with the sextant and to read the compass at a water-front school in Tampa, Florida.

The beginning of the modern apprenticeship system is found in the gild organizations of the Middle Ages. At that time the apprentice lived with his master, who was responsible not only for his trade training but for his physical and moral well-being also.

The Industrial Revolution, which took place in the latter part of the 18th century and resulted in the introduction and development of labor-saving machinery and the subdivision of trades and the specialization of labor, was the beginning of the breakdown of the apprenticeship system. The apprenticeship idea was appropriate only for the time at which it originally flourished. Then industry was local, and the relations between apprentice and master were personal. The system at that time was equally beneficial to apprentice, master, and the industry; but today these conditions are all reversed, and most apprentice schemes are merely a device to get young men to work at low wages for a long period of time, and at best the trade is merely a specialized branch consisting mostly of tool manipulation.

The state of Wisconsin recognized this condition by passing, in 1909, an "apprenticeship law," with a state supervisor in charge who must approve the indentures of any apprentice before they are legal. This law sets up certain standards that must be conformed to, among which is one that not less than five hours per week must be devoted to study on the employer's time. Another is that the whole trade must be taught, with a definite statement of the amount or time to be spent at each process or machine.

For many years a few of the large manufacturing and service corporations have maintained schools and classes for the training of their employees. In September 1913, at Dayton, Ohio, representatives of these corporations organized the "National Association of Corporation Schools," with a central office at Irving Place, New York City.

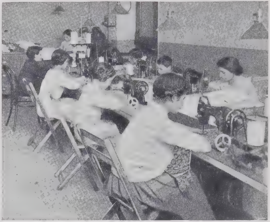
In the school system the beginning of vocational education is directly traceable to development of the idea of handwork as a factor in education. "Learning by doing," "Things before words," were some of the slogans. The great educators Comenius, Rousseau, Pestalozzi, Froebel, Herbart, all advocated the use of the constructive instinct as a means of education. Their theories were the basis of manual training, which was the forerunner of vocational education in our schools.

On Feb. 23, 1917, Congress passed the Smith-Hughes vocational education bill, which granted substantial financial aid to all forms of vocational education of less than college grade. This includes agricultural education, home economics, trades and industries education, and special classes of commercial education. The essential requirements for classes organized under this act are: (1) The instruction must be of less than college grade; (2) no students may be under 14 years of age; (3) the classes must be established and maintained under public supervision and control; (4) the qualifications of teachers must meet the requirements as set up by the state and federal boards of vocational education. Six types of schools or classes may be organized under this act, the first two of which run on the whole-time, and the others on a part-time basis:

1. *The unit trade school.*—In such schools 30 hours is the minimum week, of which 15 hours must be spent at one trade, and nine hours at science, mathematics, and drawing closely related to that trade. The remaining six hours may be spent at general subjects, such as English, history, hygiene, etc. This type of school is known as trade preparatory, because the student is prepared to enter a definite trade. This school is designed to give a balanced course of instruction, and is more directly related to the apprenticeship idea than any other type.

2. *The general industrial school.*—These schools are established in cities of less than 25,000 population, where it would be difficult to get large enough groups for instruction in particular trades, and where the trade would be overcrowded if such groups were trained. The essential difference between the unit trade and the general industrial school is that the shop work of the latter may be of a general industrial character, giving experience in a number of trades.

THE CRAFT OF THE SEAMSTRESS



Skilled needleworkers are always in demand. These young girls in a class organized by the Children's Aid Society of New York are receiving instruction that will enable them to command at once the wages due skilled workers, avoiding the ill-paid "learners'" stage.

Large numbers of boys and girls leave school without reaching the eighth grade, and without any preparation to enter industry. For the benefit of these young people part-time classes are established in the factory or store, or in a nearby school building. The essential requirements for Federal aid in part-time classes are: That the classes shall be held during the regular working day; that a minimum of 144 hours per year be spent in these classes; and that such subjects shall be taught that will enlarge the civic and vocational intelligence of workers over 14 years and less than 18 years of age. Under these conditions the following types of part-time classes are arranged:

3. *Part-time trade extension classes.*—This type of class is designed for those boys and girls who have definitely entered employment, working at a specified trade. The subject-matter of such classes must be closely related to the trade at which they are working.

4. *Part-time trade preparatory classes.*—The instruction in this type of class must be designed to fit the students for useful employment in a trade or industrial pursuit other than the one in which they are employed. The idea is to prepare boys and girls who are in "blind-alley jobs" or "juvenile occupations" for entrance into a recognized trade.

5. *Part-time general continuation classes.*—The subjects taught in these classes may be anything to improve the vocational and civic intelligence of the pupils, with the exception of trade preparatory or trade extension subjects.

6. *Evening industrial classes.*—An evening industrial class for either men or women is a class open to the public without payment of tuition, the purpose of which is to give instruction in a specified trade and supplemental to the occupation which the students follow during the regular working day. There has been considerable criticism of this regulation because it eliminates those who desire to prepare for entrance into a trade.

Classes in agriculture and home economics have been organized under the Smith-Hughes law with slightly varying requirements designed to fit these classes to the particular needs of the students.

During America's participation in the World War, the War Department of the United States government showed what could be done in the rapid and effective training of enlisted men to be army mechanics of various kinds. The vocational training of disabled soldiers was provided for in the Smith-Sears Act of Congress (1918), while the Smith-Bankhead Act contains similar provision for the reëducation of industrial cripples. In the administration of these various laws of the national government, the Federal Board for Vocational Education, with headquarters in Washington, plays the leading part.

VOICE. Do you see these words? Do you know what they mean? You say "Yes." I ask "Why?" How far back in biological evolution and human history would you need to go to give a perfect answer to this "Why?" Very far, I am sure.

Each printed word means something because it stands for a spoken word. A spoken word is a part of the language or "tongue-age." We say that English is our native "tongue." A language consists of a number of sounds and groups of sounds to which all people speaking the given language attach the same meanings. We could not make appropriate sounds for language purposes unless we had a voice organ. We could not understand them unless we had hearing organs. So you see upon these two classes of organs depended the development of language, with all that it has meant for human progress and happiness. While gesture may be older than spoken language, we can hardly imagine a deaf and voiceless race as making much progress in civilization.

The chief voice organ is not the tongue, as the word language would imply, although the tongue has quite a part. The voice organ is the larynx, the cartilaginous box between the windpipe and the base of the tongue. It is composed of nine cartilages, all connected by muscles. The largest cartilage is the thyroid;

this consists of two square plates united in front to form the projection called the "Adam's apple." The thyroid cartilage comprises most of the front and side walls of the larynx.

Across the inside of the voice box extend two tough, thin, fibrous bands, fastened at the front and rear. These bands are the vocal cords. Certain muscles by moving the cartilages can tighten these cords.

In ordinary quiet breathing these muscles and vocal cords are relaxed, and there is a wide slit between the cords, through which the air passes in and out without making any noise. But if we wish to speak or sing, the muscles tighten the vocal cords and the air as it is forced out of the lungs sets the cords vibrating. This vibration is the basis of the human voice, but the sound so produced would not be loud enough. The cavities of the throat, nose, and mouth take up the sound and reinforce it, as the sounding box of a violin or guitar reinforces the sound of the vibrating strings.

The loudness of a tone depends on how hard the air is forced out over the vocal cords. The pitch of a sound depends on the tightness of the vocal cords. For a high tone the muscles of the larynx are strongly contracted and the cords are very tense. For a low pitched tone the reverse is true.

The quality or "timbre" of a voice, by which we can tell one voice from another, is due to the shape of the cavities above the cords. Every movement of the tongue and neighboring muscles modifies the shape of the mouth and throat and consequently modifies the quality of the voice. The quality can therefore be changed by practice, as singers know.

A man's vocal cords are larger and heavier than those of a woman. Hence a man's voice is lower pitched. This difference is exactly like the difference between the sounds produced by long heavy wires of a piano, and those made by the short, smaller wires.

A boy's vocal cords are at first short and light like those of a woman, therefore the boy sings soprano or alto. At about 13 years of age the boy's vocal cords begin to grow rapidly. For a while his voice cracks and is unmanageable. Later it settles down to the pitch of an adult man. Then he sings bass or tenor.

Singing consists in the production of tones whose vibration numbers have a definite, simple relation to one another. What we call harmony of sound depends on these mathematical relations. For example, if one is an octave above another, it is because the vocal cords make twice as many vibrations per second for the first as for the second tone. (*See* Sound.) The ordinary range of a human voice is about two octaves.

Birds and many other vertebrates have voice organs connected with the respiratory apparatus. Man is the only animal that has developed a complete language, although in other animals the voice serves as a means of signaling. For example, everybody has heard the clucks of an old hen as she calls her chicks and how the sound changes if a hawk swoops near.

Certain monkeys are said to have such a definite series of sound signals or symbols as really to constitute an elementary language. A parrot can be taught to speak a number of words, but they probably do not mean much to the parrot; and such a process of imitation can hardly be called language.

FIERY MOUNTAINS *that Build* THEMSELVES

The Use of Steam Power in Their Building Operations—When is a Volcano Dead? It's Hard to Say—Relation of Earthquakes and Volcanoes—How Old Vesuvius Shakes the Earth—The World's Great Firing Line

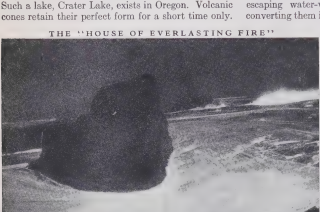
VOLCANOES. A volcano is a vent or opening in the earth's crust from which hot rock is ejected. In many but not all cases, the hot rock is in the form of lava. The lava may flow out quietly, or it may be ejected forcibly. In the latter case much or all of it may be solid. Small fragments of solid lava are called cinders, but if they are as small as particles of fine sand or dust, they are called ashes, or better, volcanic dust. Volcanic ash does not, however, imply combustion. It is nothing more nor less than powdered lava. Besides the lava which issues from volcanoes, either in the liquid or solid form, many gases or vapors escape from the vents. Among the latter, vapor of water is most abundant. Steam is, indeed, the principal force in the violent expulsion of materials from volcanoes of the explosive type. Chlorine and sulphur and various compounds of these elements are among the commonest fumes escaping from volcanic vents. Carbon dioxide also is one of the common gases. Many of the gases are noxious, so that it is sometimes difficult to approach the openings whence volcanic products issue.

The solid material and the liquid lava which escape from volcanoes accumulate about the vents and build up volcanic cones. In the top of a volcanic cone there generally is a depression, called the "crater," in the bottom of which the vent is situated. When a volcanic cone becomes high, the lava may break through its sides instead of flowing over the top. Cones built up by lava flows have low slopes; cones of cinders have steeper slopes, but rarely more than 25 or 30 degrees. When a volcano ceases to be active, it is said to be extinct if the quiescence is permanent. When it becomes extinct, however, it really ceases to be a volcano. When the activity of a volcano is temporarily suspended, the volcano is said to be dormant; but it is often difficult to tell whether a volcano is extinct or only dormant. Vesuvius was thought to be extinct until the time of its destructive eruption in 79 A.D. When this occurred, it was seen that the volcano had been dormant only, instead of dead. A volcanic vent often continues to give off vapors and gases long after lava ceases to issue. Vapors and gases also escape, and often in large quantities, during periods when no lava is being ejected.

Lakes in the Volcano's Mouth

When volcanoes cease to be active, their craters may be occupied by water, giving rise to crater lakes. Such a lake, Crater Lake, exists in Oregon. Volcanic cones retain their perfect form for a short time only. Erosion by rain and melting snow soon modifies them. Volcanic cones in all stages of degradation occur in many mountainous regions. Mount Shasta in California, Mount Rainier in Washington, and San Francisco Mountain in Arizona are examples of volcanic mountains in process of degradation. In southern California and northern Arizona there are volcanic cones formed so recently that they have been modified scarcely at all by erosion. In many of them the craters still are preserved. These fresher cones are largely of cinders.

THE "HOUSE OF EVERLASTING FIRE"



On the eastern slope of the great volcanic mountain of Mauna Loa, Hawaii, is the crater of Kilauea, 3 miles long and 2 miles wide, at the southwest end of which is the boiling lava lake called Halemaumau or "House of Everlasting Fire."

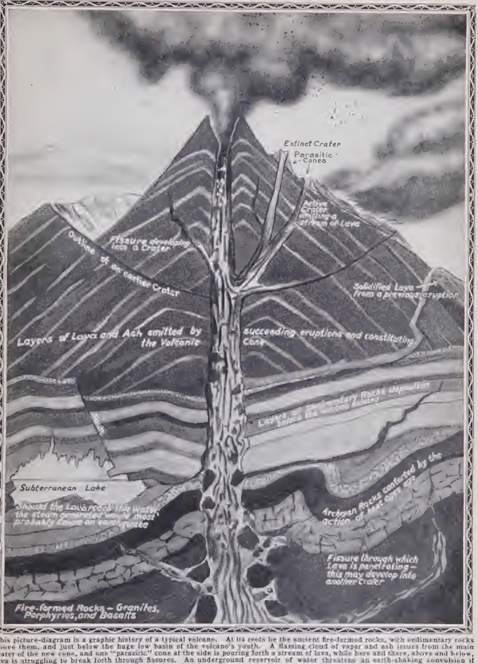
Volcanoes are often associated with earthquakes, and the violent eruptions of volcanoes sometimes are the direct cause of earthquakes. In many cases, however, it may be true that the two phenomena, the earthquakes and the volcanic eruptions, are to be referred to a common cause rather than either to the other. In the explosive eruptions of Vesuvius the quakings are felt for considerable distances from the crater. In many cases of violent eruption the old cones are partly or wholly blown away. Even large parts of islands where they occur may be demolished. Outside the present cone of Vesuvius there is a remnant of an older cone, partially destroyed in a violent eruption subsequent to its formation. A large part of the island of Krakatoa, between Sumatra and Java, was blown away in the eruption of the volcano of the same name in 1883. The shock of this cataclysm was felt straight through the earth's diameter.

The great destructiveness of volcanic action is more commonly due to the material blown out than to the lava which flows out. The flow of lava usually is slow, and in most cases it flows but a short distance before it congeals. But the solid matter may be widely distributed. It was by ashes ejected from Vesuvius that Pompeii, with its 2,000 people, was buried in 79 A.D. Torrents of rain, due to the condensation of the escaping water-vapor, often fall with the ashes, converting them into a sort of hot fluid mud, and this sometimes is most destructive in its flow. In the Krakatoan eruption of 1883 it has been estimated that bits of pumice and dust were sent up into the air 20 miles by the violent explosion; some of the dust was carried by currents in the upper air completely around the earth. Large blocks of lava sometimes are hurled miles from the volcano whence they are ejected.

The number of active volcanoes is estimated to be between 300 and 400. About one-third of the active volcanoes are situated on the continents, the others on islands. Most of the volcanoes on continents are relatively near their borders, though extinct volcanoes occur at great distances from the coasts. Continental volcanoes are, on the whole, more numerous about the borders of the Pacific Ocean than about the Atlantic. Many islands are really nothing more than the crests of volcanic cones which have been built up above the surface of the water. There are doubtless very many volcanic cones the tops of which are still below sea level. Of such submarine volcanoes little is known. The lava which issues from volcanoes comes from the interior of the earth, but from what depths is unknown. Active volcanoes are more numerous in regions where the formations are relatively young than where they are old. They are thought to occur in regions where the crust of the earth is in movement, that is, where it is either sinking or rising, rather than in regions where it is stable.

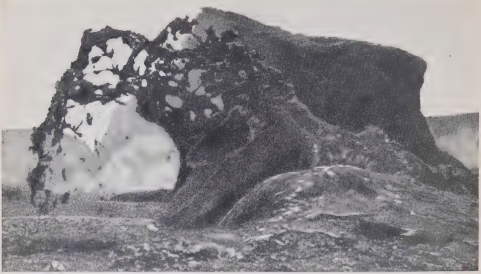
No existing volcano seems to have been active for a period of time which would be considered long, as geologists reckon time, though many of those now known have been active since the beginning of the historic period. There is reason, however, to believe that all existing volcanoes will in time cease to erupt and new ones will doubtless come into existence. Volcanoes have been more numerous at some stages of the earth's history than at others, but some of the periods of great volcanic activity were early in the earth's history, and some late. On the whole, it cannot be affirmed that volcanic activity has increased or decreased as the history of the earth has advanced, though the volcanic regions have shifted about.

ONE OF EARTH'S VAST FIERY CHIMNEYS


Extinct Crater
Parasitic Cones
Active Crater emitting a stream of Lava
Fissure developing into a Crater
Outline of an earlier Crater
Solidified Lava from a previous eruption
Layers of Lava and Ash emitted by succeeding eruptions and constituting the Volcanic Cone
Layers
Rocks deposited
Subterranean Lake
Should the Lava reach this Water, the steam generated would most probably cause an earthquake
Archaean Rocks contorted by the action of
Fissure through which Lava is penetrating — this may develop into another Crater
Fire-formed Rocks — Granites, Porphyries, and Basalts

This picture-diagram is a graphic history of a typical volcano. At its roots lie the ancient fire-formed rocks, with sedimentary rocks above them, and just below the huge low basin of the volcano's youth. A flaming cloud of vapor and ash issues from the main crater of the new cone, and one "parasitic" cone at the side is pouring forth a stream of lava, while here and there, above and below, lava is struggling to break forth through fissures. An underground reservoir of water threatens an earth-shaking convulsion if the hot lava should reach it, for then it would burst into steam with explosive violence.

A ROARING LAVA FOUNTAIN IN KILAUEA CRATER



The photographer had set up his camera on the shaking rampart of the molten lava lake, "in a temperature hot enough to fry an egg." Just as he was ready to photograph the crag that you see in the center of the picture, a terrific blast of seething lava burst with a bellowing roar within 30 feet of the camera, sending up this fountain of boiling lava spray.

Various plans have been proposed for harnessing volcanoes and using their immense reservoirs of energy for industrial purposes. This has actually been successfully done on a small scale in Tuscany on the west coast of Italy. Borings have been sunk into the volcanic mountain-side near Larderello and the steam issuing from the artificial geysers thus produced has been used as a source of heating for engines generating electric current. This current is carried to Florence, Leghorn, and other communities, where it is used for power and traction. Projects have also been proposed for thus harnessing the energy of the great volcano Kilauea in Hawaii.

VOLGA (*vŏl′gȧ*) **RIVER.** The greatest river of Europe rises in the cold marshes of the Valdai Hills, about 200 miles south of Leningrad. Sweeping with vast slow curves to the southeast and the south, it is joined by the Oka at Nizhni-Novgorod, the city of the great bazaar, and by the Kama below the towered citadel of Kazan. Past Samara, Saratov, and the mosques and minarets of Astrakhan it flows, watering the sandy Caspian steppes before it sinks through 200 mouths into the Caspian Sea after a journey of 2,325 miles.

Navigable, with its tributaries, for many thousand miles, "Little Mother Volga" is not merely the great commercial highway of Russia but a link between Europe and Asia. Down its course go the manufactures and timber of the north; upward travel grain from the Ukraine, hides from the steppes, fish from the river's own teeming mouths, oil from Baku, and cotton from Persia. Emptying into the landlocked Caspian, the Volga has no natural communication with the ocean, but a system of canals connecting its upper courses with the Neva remedies this deficiency and makes Leningrad the chief port, as it were, of the whole Volga basin.

Fifty million people—of Slavic and other races—inhabit the fertile basin of the Volga and its tributaries, and an even more motley human stream—White and Red Russians, Great and Little Russians, Cossacks, Georgians, Circassians, Armenians, Persians, Chinese, Turkomans, and gipsies—flows up and down its surface; it is the mixing-bowl of Russia. Five centuries and more—from the 10th to the 16th—were needed to make the Volga Russian from source to mouth, and the Greek cathedrals, Lutheran churches, and Moslem mosques along its banks typify Russian history as the plaintive songs of the Volga boatmen seem to express the inmost Russian soul.

VOLTAIRE (FRANÇOIS MARIE AROUET) (1694–1778). Many people have hated injustice, tyranny, and narrowness as much as Voltaire, but few have had his waspish anger against it, his dancing eagerness to attack it, his hot bitter memory to keep up the fight, his sharp laughing brilliant wit which cut and pierced like a sword.

Voltaire's long life was a thrilling one, with the dust of struggle rising all along its road. It began at Paris, where the tiny pale baby that he was appeared daily to be about to die. And all his life long he was ill, thin, nervous, drugging himself with endless cups of coffee. In his youth he shocked his simple old father by his gay idle habits, his indifference to the study of law, and his habit of writing bold, cutting, witty, dangerous verses for a pastime. In those days, when the tyrant Louis XV was king of France, it was not at all safe to make even the smallest joke about powerful men or the church, no matter how bad and unjust they might be. To be sure, it was Voltaire's own pen that first and finally aroused people against this tyranny, but that was later on.

Young Voltaire turned off so many biting and clever little poems that one day he was accused of some which reflected on the government—although he did not write them—and was thrown into the Bastille. While there he changed his name from Arouet to Voltaire, saying that he hoped to have better luck with his new name than with the old one. Eight years later he was again unjustly imprisoned there, and in a rage he departed for England. There he found freedom, for men of genius were honored and could say and write what they thought without fear of tyrants. After three years, in 1729, Voltaire returned to France with a new vision of liberty in his black, sparkling, mocking eyes, and its hot flame in his daring, generous, rash, unfrightened heart. It was there that his public life really begins.

A Genius with a Fighting Pen

That life is too busy and complicated to tell in detail. He wrote play after play, and some 'Letters on the English' which told the French king such unsugared truth that Voltaire was obliged to beat a hasty retreat from Paris to Lorraine. Indeed Voltaire was always setting off some social or literary bomb, then taking to his heels until it was safe for him to return. He was constantly in a tangle of quarrels, never allowing an insult to pass, and then turning around and heaping his beaten enemy with kindness. His books were continually being censored and burned, and he was continually writing others twice as brilliant and startling.

Among the first things Voltaire did after his flight to Lorraine was to print and circulate a statement of Newton's philosophy. At that time the philosophy of Descartes was taught in schools and insisted upon everywhere. Voltaire laughed at Descartes. As usual, his book on Newton was prohibited. But in ten years it was the accepted philosophy, and Cartesianism was all but dead. This is just one example of the way Voltaire could make his ideas prevail, until it has been said that he "filled the 18th century." He reasoned so keenly and could make the facts of science and history and the new moral and political ideas so entertaining that people read them, talked about them, and believed in them before they realized what was happening.

But Voltaire did not accomplish his wonders without constant persecution from the government. Therefore when, in 1750, Frederick the Great of Prussia invited him for a long visit to his court, Voltaire unwisely went. There he learned something about the favor of princes, and returned in three years homesick and angry. But the French king would not allow him to return to Paris. So he bought the estate of Ferney, on French soil, 3½ miles from Geneva, Switzerland, where he could easily dodge across the border if the king sent to arrest him. There he was to know as much peace as his restless soul could. He built a large house, entertained famously, gave a home to needy relatives and to the niece of Corneille, lifted his peasants from starvation to comfort, sheltered religious refugees from Geneva, started a prosperous watch factory, a silk stocking factory, and a lace colony; wrote and produced plays, managed lawsuits, defended people persecuted for their religion, and ran a farm. What was there that Voltaire did not attempt and succeed in?

Ends His Days in Honor

He returned to Paris when he was an old feeble man of 84. He was fêted, honored, adored, to his proud heart's content. He produced his last play there, and drew up a plan for a French dictionary which is still the model for English and American dictionaries. But the excitement and exertion killed him, just as the first muttering of the great French Revolution could be heard. Thirteen years later, in the midst of this Revolution, his body was carried in state through the streets and placed in triumph on the ruins of the Bastille where as a youth he was imprisoned.

Rousseau is called "the father of the French Revolution," but it is doubtful whether his teachings of "Liberty, Fraternity, and Equality" would have been heard if the mocking laughter of Voltaire had not first stung and quickened the public mind. Voltaire tore out the poisonous weeds of superstition, intolerance, and unreason, so that the ground could receive Rousseau's planting. He flew at injustice, ignorance, and tyranny with such strength and laid them so low that today we can scarcely fancy how deadly those things were. He was accused of being an "infidel," but in reality he was a "deist"—that is, one who believed that God reveals himself only in the world of nature and the hearts of men. The legend that he died in a state of terror and despair is undoubtedly false.

Voltaire was great as a dramatist, historian, poet, critic, and philosopher; but we like best to look back on Voltaire the man—the slender, ill, gay, spiteful little knight of justice, fighting with such good humor and such courage against giant wrongs, the rescuer of man's right to *think*. It is often said that Voltaire ruled the thought of Europe in his time, just as Erasmus, Petrarch, and Goethe did in theirs.

Voltaire's chief works were: 'Oedipe' (1718); 'La Henriade' (first complete edition, 1728); 'L'Histoire de Charles XII' (The History of Charles XII), 1731; 'Zaïre' (1732); 'Le Temple du goût' (The Temple of Taste), 1733; 'Lettres anglaises' (Letters on the English), 1734; 'Remarques sur les pensées de Pascal' (Remarks on the 'Thoughts' of Pascal), 1734; 'Alzire' (1736); 'Mahomet' (1742); 'Siècle de Louis XIV' (The Century of Louis XIV), 1751; 'La Pucelle d'Orléans' (The Maid of Orleans), 1755; 'Essai sur l'histoire générale et sur les moeurs et l'esprit des nations' (Essay on General History and the Customs and Mind of Nations), 1756; 'Candide' (1759); 'Dictionnaire philosophique' (Philosophical Dictionary), 1764.

VOSGES (*vōzh*) **MOUNTAINS.** These mountains of France have long constituted the chief defensè of that land against invasion from the east. It is said that in the World War of 1914–18 a German general was ordered by the emperor to attack the French and drive them back over the crest of the Vosges. After three unsuccessful attempts he was ordered to cross the mountains at all hazards. Following the fourth failure the general, before committing suicide, sent this message to the kaiser: "The Vosges cannot be crossed. Come and try it yourself."

Unlike the Alps with their lofty, snowclad peaks, the Vosges are rather low mountains with rounded summits—in aspect very similar to the mountains of the Black Forest which lie across the valley of the Rhine. In the process of mountain-making, a thick shell or crust of the earth's surface was bowed up, forming a great broad arch with its crest in a nearly north and south direction. Along that crest there developed two parallel breaks, and a broad belt at the top of the arch between the two great breaks dropped down several thousand feet, forming the valley of the Rhine. The Black Forest mountains are the eastern part of the arch and the Vosges the western. The ascent of the latter range from the east is very steep and difficult. This fact and the lack of practicable passes leading over the mountains made it impossible for the Germans to cross, while the French, on the other hand, could easily ascend the gradual western slope to defend the crest.

The Vosges mountain range proper is less than 100 miles in length. It extends from Belfort northeastward almost to Saverne, and at its widest point near Colmar is about 30 miles wide. While Alsace was in the possession of Germany, the boundary between the country and France lay along the crest of the Vosges Mountains. The name Vosges, however, is sometimes extended to cover the uplands to the north of the mountains, reaching as far as Mainz. Dense forests clothe the lower slopes of the Vosges, enveloping their outlines in a somber mantle. On the rounded, grassy tops of almost uniform height (about 3,000 feet) sheep and cattle are pastured. The forests on the slopes furnished much of the timber used in the trenches of the Allies. The Vosges range is composed mainly of granite and red sandstone, and contains large deposits of iron, lead, coal, salt, and copper.

VULTURE. "Black giants of the air" is a name that well describes many members of this family of birds of prey; for they are not only the largest of that order but also possess traits of character usually ascribed to the fabled giants of the storybook.

Unless seen high in the air, these birds are not a pleasant sight. Their feathers have a rough and unkempt appearance, the eyes are conspicuous and hard, the great beak and talons are often smeared with decaying flesh; and the thought of their repulsive habits is most repellent. They are carrion feeders and, unlike the Giant of the Bean Stalk story, they do not follow the scent of "fresh meat" only, for animal matter in a most offensive state of decay is their favorite diet.

Vultures build no nests, but lay two or three eggs in rock cavities, caves, or hollow trees. The young are fed on food that their parents have eaten and which they regurgitate, or throw up, for the young.

The Old World vulture, because of a structural difference, belongs to a different family from the American vulture. His habits, however, are the same. European vultures are found in the Mediterranean regions and south almost to the Equator. The *lämmergeyer* (lamb vulture) or bearded vulture of the Alps is a connecting link between the vulture and eagles. It sometimes has a wing spread of ten feet.

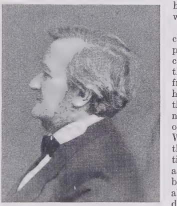
Of the American genera, the California vulture is the most remarkable. It is four and a half feet long, with a wing span of 11 feet. Though once very common in California, it is now almost extinct. In the zoölogical gardens of the whole world less than a dozen of these birds are to be seen. This may be accounted for by the fact that stock men in California formerly followed the practice of ridding their ranches of bears, mountain lions, and other animals by baiting them with poisoned carcasses. The vultures also gather about these baits and great numbers were destroyed in this way. (For other species of vultures in the United States, *see* Buzzard.)

The condor is the great vulture of the Andes. In appearance it differs from the California vulture only in the skin coloring of its bare head and in the display of more white in its wings (*see* Condor).

Vultures belong to the order of birds of prey (*Raptores*). American vultures, family *Cathartidae;* European, *Gypaetidae*. California vulture, *Gymnogyps californianus*.

WAGNER (*väg′nẽr*), Wilhelm Richard (1813–1883). More than any musician of his time, Wagner placed his own characteristic stamp on every established form of music, though he is usually thought of especially as the man who re-created opera by giving it hitherto unknown power and beauty.

Wagner was born at Leipzig, Germany. His stepfather was a celebrated actor who did much for the boy. As a schoolboy Wagner was eccentric and independent of established customs, but he became an excellent Greek scholar. His musical ambition was fired by the works of Beethoven and Weber; and when he was but 17 his first overture was performed at a theater in Leipzig, astonishing the audience by its continuous use of the drum, even as his later music astounded the musical world by the crashing combinations of other instruments.


WAGNER
Creator of the Music Drama

For the next 12 years Wagner filled positions as chorus master in various cities. He went to Paris, hoping to produce his opera 'Rienzi', but was disappointed. However, it was most successfully produced in Dresden and resulted in Wagner's appointment as musical director of the Saxon court. Here his operas 'The Flying Dutchman' and 'Tannhäuser' were brought out, amid mingled criticism and praise; for Wagner's operas do not follow the fashion of former operas. His story is a real drama and Wagner made his music for both voice and instruments closely follow the meaning of the text. Thus his operas lacked the constant pretty melodies and pleasant harmonies of the popular opera, and while a few masters, among them Liszt and Schumann, saw in these new operas the beginning of a new art, the public found them "tedious" and "eccentric." When 'Lohengrin', Wagner's next opera, was written, long years passed before the composer himself could hear this beautiful work.

Wagner's revolutionary ideas were not confined to music. He took part in the German political revolution of 1848–49 and for this was obliged to leave the country. He found refuge in Switzerland, and remained in exile for about ten years.

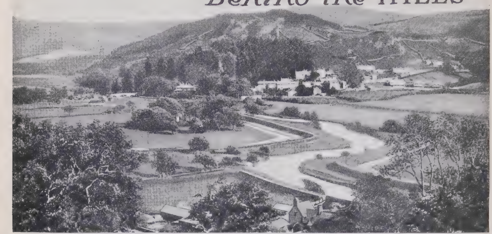
In 1864 the king of Bavaria invited Wagner, who was now in very straitened circumstances, to come to Munich and continue his musical work. The 12 years of his residence there saw great progress. Here his series of operas based on the old German Nibelungenlied were composed. His operas published during and after this time are known as music-dramas, for in them he worked out his theory that a combination of all arts is necessary to produce a perfect art unit. Thus literature, music, and action have equal part, and great attention was given to scenic accessories.

But for such stupendous spectacles the opera house of Munich proved inadequate, so Wagner conceived the idea of a "festival theater" especially constructed from his own designs. The king heartily approved the project and the outcome was the famous Wagner theater in Bayreuth, a city of northern Bavaria. The first Wagnerian festival was held in this theater in 1876, and since that time almost every year has seen a series of performances attended by thousands of music lovers from all parts of the world. After his death in Venice, where he had gone for a season of rest, his body was brought to Bayreuth for burial.

Wagner's music dramas, especially those based on the old Nibelungen tales, are among his most noted productions. These include 'Das Rheingold', 'Die Walküre' (The Valkyries), 'Siegfried', and 'Götterdämmerung' (The Twilight of the Gods). 'Tristan und Isolde' is founded on a Celtic legend and is part of the King Arthur cycle, as is also 'Parsifal'. 'Die Meistersinger' is a story of Hans Sachs of Nuremberg. Wagner wrote the text of these masterpieces as well as the music, thus proving himself a man of letters as well as a musician.

After half a century of bitter controversy over his theories and innovations—especially over the startlingly novel harmonic effects he introduced—Wagner stands out as the commanding musical genius of his century. Whether "Wagnerian" or "anti-Wagnerian," no musician of the last generation has been able to escape the master's influence and write as if he had not lived, for he impressed even his antagonists.

"The LITTLE LAND Behind the HILLS"



In the Picturesque Welsh Hills—The Village of Maentwrog in Merionethshire

WALES. One of the greatest of modern Welshmen, David Lloyd George, who was prime minister of Britain in the terrible days of the World War, once affectionately called Wales "the little land behind the hills." Really it is not only *behind* the hills, but all over and between the hills of the western part of Great Britain. Wales (from the Anglo-Saxon *walas*, meaning "foreign") is a great peninsula 136 miles long, north and south, by 96 miles wide at its broadest part. At the northwest corner, cut off by the narrow Menai Strait, is the island of Anglesey (276 square miles), with its port of Holyhead, from which steamers sail for Ireland. The River Dee, with England's stronghold of Chester at its mouth, comes into the north of Wales, and Bristol Channel and the Severn's mouth to the south; while Carnarvon Bay, Cardigan Bay, and Carmarthen Bay deeply indent its western shores. Snowdon (3,560 feet), the highest west of England and Wales, lies 18 miles southwest of Menai Strait. The land is one of the richest in minerals in the world, for in addition to enormous beds of the best coal, there are extensive deposits of iron, copper, zinc, tin, lead, and even some gold. One-fifth of all the coal of the British Isles is produced in Wales, and Cardiff (205,000 population), on Bristol Channel, is the greatest coal-shipping port on the globe. Other cities of importance are Swansea and Merthyr Tydfil, both in the same great mining district with Cardiff. With an area of 7,466 square miles, Wales has about 2,210,000 people.

The Welsh are of Celtic stock and have a language akin to the *Erse* or *Gaelic* of Ireland and the Scottish Highlands. Like all mountain peoples the Welsh have many legends and traditions; indeed Wales may almost be called the home of British folklore and old stories. It is the land of King Arthur and his Round Table, of the "island valley of Avilion," and of Camelot. The Anglo-Saxon conquest of Britain (5th and 6th centuries A.D.) served to drive the Britons into the fastnesses of the western mountains, and the Welsh are their descendants. Behind Snowdon and other mountains the Saxons could not well follow. The country remained independent, under native princes, until Edward I of England subdued it (1282) and gave to his infant son the title "Prince of Wales." That son later succeeded to the throne of England, and from then on the heir to the English throne has been known as the Prince of Wales. During the reign of the Lancastrian Henry IV, Owen Glendower carried on a war for Welsh independence and won his place as the chief of Welsh heroes. But the reign of Henry V saw Wales once more subdued.

The Tudor Henry VII developed a Council of Wales, a kind of subordinate Privy Council, which gave close attention to the administration of the country. The Tudor sovereigns, being of Welsh descent, took an especial interest in the country and gave it representation in Parliament and a local organization similar to that of the English in place of the old tribal law and organization. English common law and English judges and juries brought order and peace to the country. "A better people to govern, Europe holdeth not," said Sir Henry Sidney, who was sent by Elizabeth to rule Wales.

The Reformation was not kindly received in Wales, in the beginning. The people found the established Church of England not so considerate of their customs and of their religious enthusiasm as Rome had been, and Catholicism lingered long. Later Puritanism won many converts, and in the 18th century the great Wesleyan movement took fast hold on Wales, although the people wished as Methodists to remain within the Church of England. Today more than two-thirds of the people of Wales are "dissenters" of Methodist or Presbyterian denominations.

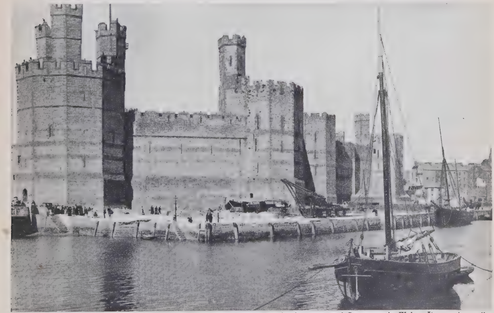
The 19th century saw the rise of modern industry in Wales. Copper and tin had long been found, and in the 19th century lead also was mined in considerable quantities. The finding of large deposits of the best coal in South Wales changed the whole character of Wales, industrially and politically. Along with the mining industry, modern agriculture has come in. Wales, although much more thinly populated than England, is well farmed; the Welsh tenant is likely to have a 100-acre holding and to be a most progressive farmer. The latter part of the 19th century saw also the development of parish councils, of district councils, and county councils, revolutionizing the local government of Wales, as also of England. The influence of the great landlords has diminished and local aspirations now find a voice in the British Parliament at Westminster. Wales has played an increasing part in British politics. In general the Welsh are Liberals, and it was the Liberal party that put through in 1914 the long-wished-for Welsh Church Disestablishment bill by which the English church in Wales is no longer to be allowed its position as an established church to which all must pay tithes. Although suspended for the duration of the war, it came into operation in 1920.

In recent years there has been a marked revival of Welsh nationalism. Not that anyone thinks of independence—Wales is fairly content with its position in the British Empire; but there is a new interest in restoring the Welsh language, in publishing the Welsh histories and poems. Welsh music is sung at periodic festivals and Welsh traditions are hunted down and fitted into the body of folklore. Thus there is growing up what may be called a Welsh "culture," giving new richness and variety to the strong fabric of British civilization.

WALL PAPER. The wall paper in your house is a descendant of the wonderful tapestries with which the walls of feudal castles were hung in days gone by, but which were so expensive that none but the very rich could afford them. Today the wall paper industry fashions millions of yards of beautifully tinted and artistically designed wall paper every year, and few, indeed, are the homes so poor that the walls cannot be attractively covered.

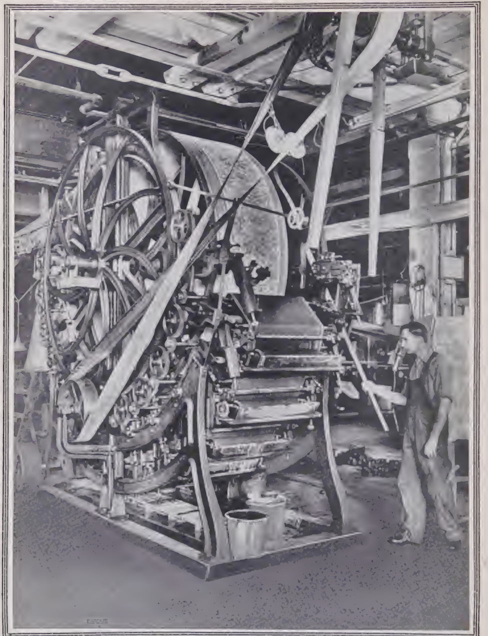
The machines which print our wall paper are mechanical marvels. They work on the same principle as the rotary presses used in printing such cotton

CARNARVON CASTLE IN WALES



This magnificent old castle—the finest in the United Kingdom—stands in the seaport of Carnarvon in Wales. Its massive walls, from 8 to 14 feet thick, and its 13 polygonal towers speak powerfully to the imagination of the stern war-troubled days of the feudal barons. It was begun about 1283, in the reign of Edward I. In this castle the heir-apparent to the British throne is formally invested with the title of Prince of Wales.

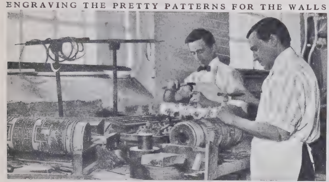
A PRESS WHICH PRINTS WALL PAPER



Almost all wall paper is printed from rotary presses like this one, into which the paper is fed from rolls. The paper passes over the large drum or cylinder, while the design is printed on it by rollers into which the pattern has been stamped. The machine shown above has four such rollers, one roller for each color used in the design. As the paper leaves the press it is hung in drying racks which are usually several hundred feet long. When it is dry it is rolled in lengths of 8 to 16 yards and is ready for the market.

cloths as calicos, cretonnes, etc. There are separate engraved copper rollers for each color, which print the designs on the paper as it passes over a large central drum. These rollers "register" accurately so that the designs are sharper and clearer than in the old fashioned wall papers printed from wooden blocks by hand. From one series of rollers to another the long strips of paper are carried automatically, "hot boxes" along the way doing the necessary drying. Grounding machines put on the background color, bronzing machines apply a bit of gold glint to the pattern, and an embossing machine gives the appropriate finish. Another machine festoons the long rolls of paper on drying racks, and after it is thoroughly dried it is cut into 8- or 16-yard lengths.

ENGRAVING THE PRETTY PATTERNS FOR THE WALLS



In the old days only the rich merchants, the nobles, and the kings could adorn their walls with tapestry. But now even the walls of the humblest cottage can be made attractive with wall paper. The pretty designs are engraved on copper cylinders, as in this picture, and from these cylinders the rolls of paper are printed.

Wall paper did not come into general use in Europe until the 18th century. Until the 19th century, when machinery for printing long continuous rolls was invented, all wall paper was pasted up from squares of paper printed by hand from blocks. Here and there in old colonial mansions some of these old papers may be seen, still in fairly good condition. A few designs, which cannot be printed on roller presses, are still printed from blocks. John B. Howell established the first wall paper factory in the United States at Albany, N. Y., in 1790.

WALLACE, SIR WILLIAM (1270?–1305). We know very little of the early life of Wallace, Scotland's national hero, until the time when as a young man he killed an Englishman who insulted him, and for this was outlawed. Then it was that he collected a little band of followers and began the struggle against the English rule of Edward I. Gradually the number of his followers grew until all Scotland was ablaze with rebellion. As soon as an English army approached, however, the jealous and contentious Scotch nobles deserted. In spite of this Wallace defeated and almost destroyed the English army at Stirling Bridge (Sept. 11, 1297), drove the enemy entirely out of Scotland, and devastated the whole northern part of England. As a reward for this Wallace was elected guardian of Scotland and showed himself a successful governor until a new and larger English army was sent against him. Again the nobles deserted, and on July 22, 1298, he was defeated in the battle of Falkirk.

Again he sought refuge in the mountains and for several years carried on irregular warfare against the English. But at length he was captured, probably through the treachery of a Scotchman, and taken to London where he was tried, condemned cruelly, and executed as a traitor. He had failed in freeing his country from the yoke of England, but he had inspired others to carry on the struggle and a few years later Scotland's independence was secured under Robert the Bruce.

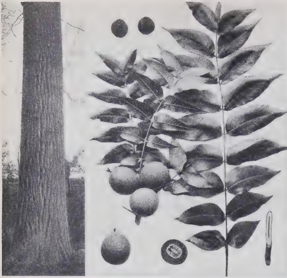
WALNUT. Every boy or girl who has ever gone nutting is familiar with the sweet, rough-shelled nuts of the black walnut tree, and recalls vividly the brown stains left on the fingers by the juicy green husks. In some parts of the country this dark brown juice is squeezed out in presses and used to darken light-colored woods. The black walnut is chiefly valued, however, for its beautifully grained dark brown wood, which is used for furniture and for the interior finish of houses. This wood is especially desirable for gunstocks because it is straight-grained, easily worked, and does not splinter.

Early settlers in America ruthlessly cut down groves of these great trees which had grown undisturbed for centuries, and either burned the wood or used it for fence rails and other purposes about the farm. As a result black walnut has become scarce, and old-fashioned walnut furniture is very highly prized. So valuable is the wood today that the stumps of trees cut down a century ago have been pulled up with expensive machinery for the gnarly-grained roots that are still sound.

The black walnut is generally distributed throughout the United States, but is least common in the Atlantic states. It grows to a height of 100 feet, with a trunk from four to six feet in diameter. The plumy yellow-green foliage is late in coming and falls early in the autumn, so that the tree often stands naked when its neighbors are in full leaf. Another species of walnut tree native to the United States is the white walnut or butternut (*see* Butternut).

The English walnut tree is cultivated for its nuts in various states, most extensively in California. It is not a native of England, but comes from the mountains of Greece, from Persia, and from Afghanistan. From it we obtain the beautifully grained wood known as "Circassian walnut."

THE BLACK WALNUT TREE AND ITS FRUIT



On the left is the trunk of one of those splendid Black Walnut trees which are now so scarce. On the right is a branchlet with three walnuts attached, while below we see a fallen nut. All of these still wear their thick husks. Above are two nuts with the husks removed, showing the black wrinkled hull. Below is a cross section of the nut and its husk.

Scientific name of black walnut, *Juglans nigra;* English walnut, *Juglans regia*. The California walnut, *Juglans californica*, resembles the black walnut.

WALRUS. "Whale-horse" is the meaning of this creature's name, and he lives up to this description. He is closely related to the seal and sea lion, but has enormous down-turned tusks, or canine teeth, projecting from the upper jaw, sometimes reaching a length of 30 inches. The tusks are of solid ivory, and are useful in defense and as an aid in digging and in climbing. The thick wrinkled skin of the old animals is almost hairless. The young ones, however, are quite thickly covered with hair of a pale brown color.

The walrus has a thick, clumsy body, deepest at the shoulders. The head is rounded, with a short broad muzzle, on either side of which is a bunch of stiff bristly whiskers. The feet, or flippers, which are adapted for swimming, are furrowed so as to hold to smooth surfaces, but do not enable the animal to move about very readily on land. Walruses normally reach a length of from 10 to 12 feet and a weight of about 2,000 pounds, though some are as much as 20 feet long.

There are two living species, one found in the Atlantic and one in the Pacific. The Atlantic form, *Odobenus rosmarus*, is found on the coast of Labrador and Hudson Bay, and formerly extended further south. The Pacific form, *Odobenus obesus*, lives farther north, being rarely found on the mainland. Both species feed largely on clams and other mollusks, which they dig from the sea-bottom with their tusks. Their fondness for oysters is alluded to in the poem of "The Walrus and the Carpenter" in 'Through the Looking-Glass'.

Walruses visit islands and ice floes, and congregate in considerable numbers during the breeding period. They have a strong maternal instinct, and a mother walrus will fight fiercely for her young. They are hunted for their hides, oil, and ivory, and their flesh is relished by natives along the Arctic coast. Their decrease is a very serious loss to native Alaska. The polar bear is their most dreaded natural enemy.

THE "OLD MAN" OF THE ICE FLOES

The Walrus is often to be seen riding gravely upon a cake of floating ice, his great hanging teeth giving him the appearance of an old man with a parted beard.

WANDERING JEW. When Christ bearing his heavy cross was on his way to Calvary, according to a well-known legend, he paused for a moment's rest before the door of a Jew named Ahasuerus. Cursing, the man struck him, and cried out: "Go, why dost thou tarry?" For an instant Christ looked at him without speaking. Then he replied, "I go, but thou shalt tarry till I come again." When the Jew came to himself he was filled with horror, fear, remorse; but from that day to this he has never ceased to wander restlessly from place to place.

There are several versions of this medieval story, some describing the Jew as a cobbler of Jerusalem, some as the carpenter who made the cross for Christ, and others as the doorkeeper of Pontius Pilate. The version given above first appeared in a pamphlet printed in Leyden in 1602, in which the bishop of Schleswig told of meeting the Wandering Jew at

Hamburg. Today the most familiar form story is that used in Eugene Sue's novel of that name and in the striking picture by Gustave Doré.

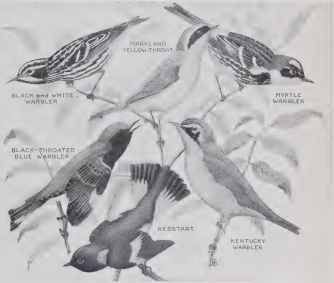
The name Wandering Jew is also given to any one of several ornamental trailing plants, often cultivated in hanging baskets. Perhaps the commonest of these is the branching spiderwort (*Zebrina pendula*) from Mexico; it has curiously striped leaves, often purplish beneath, and inconspicuous flowers.

WA'PITI. The wapiti belong to the red deer group of the deer family, and inhabit North America, Europe, and Asia. Those of North America are the finest and largest, sometimes attaining a weight of more than 800 pounds. Their antlers are cylindrical and widely branched, four or five feet long and three or four feet apart at the points. The early settlers called them "elk" and they are usually erroneously so called at the present time. Originally the wapiti was the most wide ranging of American hoofed game animals. It was found over practically the whole continent from southern Mexico to Hudson Bay, and from Labrador to California. It seemed equally at home near sea-level and above the timber-line of lofty mountain ranges. The wapiti has become exterminated to such an extent that it is now found only in Canada, Wyoming, Colorado, and the Pacific coast states. The larger number of the 40,000 or more survivors have found a refuge in the Yellowstone Park region. Wapiti thrive readily in captivity.

WARBLER. In every orchard warblers are welcome visitors. They come with the blossoms, and though seemingly at play among the trees, they really are working busily. There are but few leaves or buds that they do not inspect, and fruit-growers owe much to the vigilance of these little birds, who rid trees of the insects that menace the orchard output.

The warbler's food is composed entirely of insects and for this reason they migrate, moving north with spring and south before the frosts. Most of them nest and feed among the trees. Others live much upon or near the ground, some are expert flycatchers; others creep about tree trunks, searching the bark for insects. Many have attractive songs, but others are songsters of inferior merit. As a rule the plumage is beautiful, though not brilliant. Black, white, gray, and olive-green are found, but shades of yellow predominate.

SIX MEMBERS OF THE POPULAR WARBLER FAMILY



The Warblers are certainly as great favorites with Mother Nature as with human beings, for she seems to have tried to see in how many ways she could dress them up. A mere list of the names of the different Warblers looks like a long spelling lesson. Here are just a few of the best known.

The warblers of the Old and New Worlds belong to different families. The New World family (*Mniotiltidae*) has over 150 species. Of these one of the most familiar in the United States is the myrtle warbler. (For illustration in colors, *see* Birds.) The yellow warbler is a summer resident of lawns and parks. The black and white warbler runs over the bark of trees like a nuthatch. The black-throated green warbler nests in pine woods from southern New England northward. The largest member, the yellow-breasted chat, is noted for its night song.

Besides the species having the name warbler, a favorite member of this family is the redstart, a pert, active little bird about five and one-half inches long. It has glossy black plumage, with orange red on the wings and tail, and white under-feathers. It is found throughout the United States and north to Upper Canada. It has three distinct songs and is most generous with them.

The ovenbird, one of the most interesting members of the family, is known by voice rather than by sight. Its call "teacher, *teacher*, TEACHER," is frequently heard, but the bird is so inconspicuous amid the undergrowth of its ground home that it is rarely seen. It is named from the nest it builds—a structure of leaves, grasses, rootlets, and weed stalks, fashioned like an old-time Dutch oven.

Scientific name of yellow warbler, *Dendroica aestiva;* black-and-white warbler, *Mniotilta varia;* black-throated green warbler, *Dendroica virens;* redstart, *Setophaga ruticilla.*

The AMERICAN WAR *of* 1812

How It Grew Out of the Gigantic Struggle between England and Napoleon—Stirring Exploits of America's Naval Heroes—The Strange Treaty that Concluded It

WAR OF 1812. If the god of war ever laughs up his sleeve, he probably did so over the War of 1812. Of the six important wars in the history of the United States, this conflict stands out as the most singular in its causes, character, and results. The issues for which it was begun had practically disappeared before the first gun was fired, and the most important battle of the war was fought after peace had been declared. It was waged by the West and Southwest largely in behalf of the interests of New England, which, strangely enough, bitterly opposed it from the beginning. It was marked by a series of humiliating defeats for the American land forces which had confidently expected to conquer Canada in a summer, while on the other hand the insignificant American navy of less than 20 ships, on which no one had reckoned, met with successive brilliant victories at sea. Terminated finally by a treaty in which no mention was made of the causes of the conflict, the war is without a parallel in the annals of American history.

Causes of the Conflict

The war had its origin in European affairs. In the gigantic conflict between Great Britain and Napoleon, Great Britain gained control of the seas by her victory over the combined French and Spanish fleets at Trafalgar (Oct. 21, 1805), while Napoleon a few weeks later gained supremacy on land by his defeat of the Austrians and Russians in the winter battle of Austerlitz. Henceforth, as someone has said, the war between the two belligerents was like a conflict between a land animal and a sea animal: neither could or would grapple with the other in its chosen element.

This situation led to a fierce commercial struggle in which the interests of the United States became vitally involved. Believing that the source of Britain's strength lay in her commerce, Napoleon issued a series of decrees during 1806 and 1807 which provided that the ports of Europe under his control should be closed to British goods; by thus depriving England of her chief markets he hoped to force her to sue for peace on his terms. The British government, on the other hand, in retaliation for the Continental system, as Napoleon's plan was called, issued various Orders in Council forbidding neutral vessels to trade at any port which was closed to the British flag unless such vessels had first touched at a British harbor and had paid duties upon their cargoes to the British government. The action of both belligerents was in flagrant violation of international law. As Jefferson said, "England seemed to have become a den of pirates, and France a den of thieves."

The effect of Napoleon's Continental system and of Great Britain's Orders in Council was to threaten with ruin the growing commerce of the young republic across the sea. During the preceding 15 years the shipping of the United States had multiplied almost eight-fold, her exports had increased 400 per cent, her carrying trade had grown enormously, and the wages of her sailors had been tripled. By the policy now adopted by the warring countries this prosperity was seriously menaced, for, as someone put it, the new method of making war was like a bull-fight: Napoleon was the bull, England the toreador, and America paid the expenses of the entertainment. Interference with neutral trade, in short, was the first cause of the conflict.

A second cause of the War of 1812 was the impressment of American seamen. In common with other countries at the time Great Britain did not recognize the right of naturalization; her theory of citizenship was "Once an Englishman, always an Englishman." Least of all was she disposed, in the midst of grave national danger, to admit that British seamen, attracted by the higher wages, better food, and more kindly treatment on American vessels, could desert their ships in American harbors and enter American service under the protection of so-called naturalization papers. Accordingly, her naval commanders had strict orders to stop neutral ships and make a diligent search for deserters.

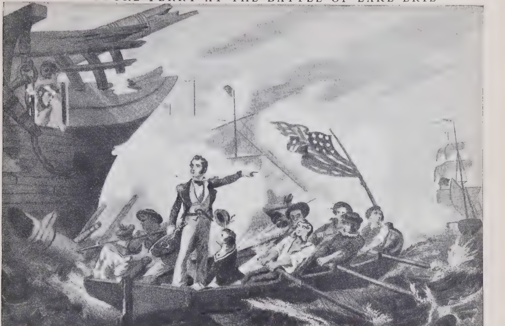
This policy of impressment proved especially obnoxious to the United States because, owing to the difficulty of distinguishing between Englishmen and Americans, many of the impressed sailors were native-born Americans. Between 1803 and 1810, in fact, approximately 5,000 American citizens were officially reported as having been forced to serve on British ships. While such sailors were released when their identity was established, this was a difficult thing to prove and occurred in most instances only after the impressed men had served under the British colors for a year or two; of the number mentioned above, for example, only 1,361 were released.

The "Chesapeake Affair"

A peculiarly intolerable instance of the exercise of the right of impressment was the unprovoked attack on the American frigate *Chesapeake* by the British ship *Leopard* (June 22, 1807), made because the American commander refused to permit his vessel to be searched for deserters. In this encounter three Americans were killed, eighteen were wounded, and four men—three of them Americans—were taken on board the British ship. Four years later, a somewhat similar controversy had a different outcome for, in this instance, the American frigate *President* forced the British sloop of war *Little Belt* to strike her colors.

A third cause of the war was the belief—especially strong in the West—that the British had for years incited the Indians to attack American frontier settle-

COMMODORE PERRY AT THE BATTLE OF LAKE ERIE



Few deeds have so fired the imagination as the heroic conduct of Commodore Oliver Hazard Perry at the Battle of Lake Erie. After his flagship, the *Lawrence*, had been literally shot to pieces, and nearly all its crew killed or wounded, Perry put off to the *Niagara* in a small boat under heavy fire, and soon after forced the entire British squadron to strike its colors.

ments. Although the truth of this charge is now questioned, it seemed then to be confirmed by British guns and powder of British origin found by William Henry Harrison among the effects of the Indians whom he defeated in 1811 at Tippecanoe (*see* Harrison, William Henry), and by the flight of the Indian leader Tecumseh to Canada after that defeat.

Numerous efforts to avoid war had been made by the American government. Upon Jefferson's recommendation Congress passed Embargo and Non-Intercourse acts. These were designed to keep American ships at home and to secure justice from the belligerents by depriving them of American goods which—so Jefferson thought—were essential for their welfare (*see* Embargo Acts). While the embargo did, indeed, injure British manufacturers, it proved even more harmful to American shippers and farmers; it was, in fact, like "holding the blade of the sword and striking the enemy with the hilt." Finally, during Madison's administration an act was passed repealing the Non-Intercourse Act, but offering, in case either belligerent should revoke its decrees against neutral commerce, to forbid trade with the other in case it, too, did not withdraw its decrees within a given time. Shortly after the passage of this act Napoleon, who never hesitated to give or break a promise if by so doing he might gain his end, notified the American minister in Paris that his decrees were revoked. This revocation, he added, was on the understanding that if England did not revoke her Orders in Council, the United States should "cause their rights to be respected." Having good reason to suspect that Napoleon had not withdrawn his decrees, the British refused to recall their Orders in Council and continued their interference with American trade.

The "War Hawks" Demand War

Further delay seemed impossible. Madison, threatened with a loss of the renomination for the presidency and urged to action by a group of fiery young Congressmen led by Henry Clay—the "War Hawks," they were called—finally sent a strong message to Congress reviewing the British aggressions and recommending war. Accordingly, on June 18, 1812, by a vote of 79 to 49 in the House and of 19 to 13 in the Senate—almost all the votes against the bill were cast by New England Federalists—war was declared against Great Britain. Five days later the Orders in Council were revoked, but the revocation was couched in such unsatisfactory terms that, although the British proposed a suspension of hostilities, their proposal was rejected and the war ensued.

The American leaders expected to conquer Canada in short order and to dictate terms of peace in Quebec or Halifax. But the government was totally unprepared for war, the regular army was poorly drilled and officered, and New England, then a large section of the country, was emphatically opposed to the conflict. Instead of a triumphal march into the enemy's territory, therefore, the first year of the struggle saw the disgraceful surrender of Detroit by General William Hull, the loss of Mackinac, the burning of Fort Dearborn (where Chicago now stands), and the whole Northwest in danger. An invasion of the Niagara region ended likewise ingloriously in the capture of the entire American force.

The next year opened no better. An effort to recapture Detroit ended in defeat at the River Raisin, in Michigan, and in the massacre of the wounded by the Indians. Later in the year an attempt to capture Montreal was also unsuccessful. Meantime, however, Commodore Oliver H. Perry had won a brilliant victory on Lake Erie (Sept. 10, 1813), and his famous message, "We have met the enemy and they are ours," inspired the Americans to new effort (*see* Perry, Oliver H.). His success opened the way for Gen. William H. Harrison to recapture Detroit and recover Michigan. Following the British into Canada, Harrison defeated them at the battle of the Thames (Oct. 5, 1813). In spite of this victory the end of the second year of the war saw the conquest of Canada almost as remote as it had been at the beginning.

In the meantime a number of stirring duels had been fought on the high seas. The American navy, while small—it numbered less than 20 ships as compared with a thousand under the British colors—was composed of well-built, swift-sailing vessels, manned by sailors who had no superiors and commanded by officers who for gallantry and daring have never been surpassed. Within half a year after the war began England had lost six vessels and captured none. Of 13 duels between well-matched antagonists, the Americans won 11.

The 'Constitution' and the 'Guerrière'

Especially famous among these combats was the victory of the American ship *Constitution*, commanded by Capt. Isaac Hull, over the British frigate *Guerrière* (Aug. 19, 1812). "In less than thirty minutes," the American commander reported, "she was left without a spar standing, and the hull cut to pieces in such a way as to make it difficult to keep her above water." Equally thrilling, although with a different outcome, was the defeat of the *Chesapeake* by the British ship *Shannon*. In the short fierce action which ensued, Captain Lawrence of the *Chesapeake* was mortally wounded. As he was carried below he gave the famous command, "Don't give up the ship." So withering was the British fire, however, that the *Chesapeake* was soon captured and was taken as a prize to Halifax (*see* Lawrence, James). By the end of 1813 the Americans had captured or sunk 26 British war vessels and had lost but 7. The preponderance of numbers, however, finally told against them and before the end of the war the British had sunk, captured, or blockaded every American frigate.

The year 1814 boded ill for the Americans. The defeat of Napoleon made it possible for the British to dispatch large reinforcements of veterans to their forces on this side of the water. Nevertheless the Americans began a third invasion of Canada. It resulted in the indecisive battle of Lundy's Lane, the bloodiest battle of the war, in which Gen. Winfield T. Scott distinguished himself. Although the Americans held their ground, their progress was checked and in the fall their troops were withdrawn. The British now attempted to invade New York, but failed, owing to the defeat of the British fleet on Lake Champlain by Commodore Thomas Macdonough.

The Capture of Washington

In the meantime an effort by the British to create a diversion in the Middle States, while humiliating to the Americans and disgraceful to the invaders, also resulted in failure. Appearing in the vicinity of Washington in the summer of 1814, General Ross with an army of 4,500 men, after overcoming feeble resistance from a superior American force, took the capital, and, on the ground that the Americans had destroyed the government house at York (now Toronto), set fire to the White House and some other public buildings. The President and the Cabinet fled, while pretty Dolly Madison bundled up the most precious White House treasures, including Washington's picture and the original draft of the Declaration of Independence, and carried them to safety. General Ross then moved against the rich city of Baltimore, but here at last he met a spirited resistance and was forced to retreat, and sailed away down the bay. It was during the bombardment of Fort McHenry, one of the defenses of Baltimore, that Francis Scott Key, a prisoner on board a British war vessel, wrote 'The Star Spangled Banner'.

Peace was made Dec. 24, 1814, but before the news reached America the most creditable land battle of the war had been fought at New Orleans, Jan. 8, 1815. Here Andrew Jackson and his band of frontiersmen, who during the preceding year had crushed the Creek Indians at Horseshoe Bend in Alabama, completely defeated a larger force of British veterans who had fought against Napoleon in Europe (*see* Jackson, Andrew). This victory aroused intense enthusiasm throughout the country, although it was soon learned that the sacrifice of life had been useless. The treaty had been signed for more than two weeks before the battle was fought.

Throughout the struggle the majority of the New Englanders had steadily opposed "Mr. Madison's War," as they scornfully called the conflict. They had refused to allow their soldiers to fight outside of their own states. Their representatives in Congress had opposed all bills for raising money and men. And finally, in December 1814, aroused by the destruction of their commerce and fisheries, which were New England's chief interests, delegates from five states met in secret convention at Hartford, Conn., and proceeded to draw up a series of amendments to the Constitution with a view to protecting their own interests against those of the South and West. No treasonable intention could be proved, but behind the whole work of the convention was the implied threat to secede if their demands were rejected.

The Treaty of Peace

Before their demands could be presented to Congress, news arrived that the treaty of peace had been signed at Ghent on Christmas Eve, 1814. The treaty was a strange one. Not a word was said in it about the Orders in Council, the searching of American ships for forbidden goods, or the impressment of American seamen, the chief things for which the United States had gone to war. The return of peace in Europe had removed the occasion of trouble, however, and both sides were glad to bring to an end a conflict which had brought no great glory to either. The war cost the United States about $100,000,000, while 21,000 sailors and 30,000 soldiers were killed or wounded. But, on the other hand, the united action against a common foe and exultation over victories won by men from all parts of the Union did much to create a truly national spirit which was eventually to take the place of the old spirit of loyalty to the state. The war also played a notable part in bringing into prominence men like Clay, Calhoun, Webster, and Jackson, who for a generation to come were to be leaders in shaping the national policies of the United States. (*See also* Jefferson, Thomas; Madison, James.)

WARSAW, POLAND. Crowning the heights above the left bank of the Vistula and looking out proudly over the fertile plain which stretches away in every direction stands Warsaw, the capital of the Republic of Poland. Through all the long unhappy years that have slipped by since the 18th-century days when she was, next to Paris, the most brilliant city of Europe, Warsaw has steadfastly turned to the world a face that was gay and vivacious despite Russia's harsh and cruel rule. And now she has come into her own again.

The city is famous for its many magnificent old churches and palaces, its splendid parks and public gardens, its monuments and tree-lined avenues. Several of the palaces which once housed the ancient nobility are now used as government offices. The University of Warsaw, one of the foremost institutions of Europe, has found a home in the stately palace of Casimir. The heart of the city is the ancient royal castle, a vast pile built on a height overlooking the Vistula. To the north of the castle is the old town, now the Jewish quarter, with its narrow streets and well-preserved old buildings. Here stands Warsaw's oldest church, the Cathedral of St. John, built in the 13th century. The splendid Ujazdowska Aleja Avenue leads to the Belvedere Palace and the Lazienki Park. This beautiful park was laid out in an old bed of the Vistula by King Stanislaus Poniatowski toward the end of the 18th century. On an island in one of its artificial ponds is the pride of Warsaw, a beautiful open-air theater.

Its central location in a great fertile plain, with abundant transportation by water and rail, has made Warsaw one of the chief commercial and manufacturing cities of eastern Europe. It manufactures machinery and metal goods, carriages, furniture, and woven goods, and has an active trade in food and animal products, principally wool and hops. Situated in the midst of one of the richest grazing regions of the Old World, it derives great wealth from the live stock industry. The Warsaw horse market is particularly famous. The city exports leather goods and is an important coal distributing center.

A tumultuous life Warsaw has had, handed from one master to another since 1655. Sweden, Austria, Russia ruled in turn, with a brief period of independence bestowed by Napoleon who, in 1807, made Warsaw the capital of the Grand Duchy of Warsaw, which survived until 1813. During the World War of 1914–18 Warsaw was captured by the Germans, who held the city until peace restored Polish independence. Population, about 980,000.

WARTS. "Talk about trying to cure warts with spunk-water! You got to go all by yourself to the middle of the woods where you know there's a spunk-water stump, and just as it is midnight you back up against the stump, and jam your hand in, and say:

> Barley-corn, barley-corn, injun-meal shorts,
> Spunk-water, spunk-water, swaller these warts;

and then walk away quick, eleven steps, with your eyes shut, and then turn around three times and walk home without speaking to anybody. Because if you speak the charm's busted."

This was Tom Sawyer's favorite cure for warts and Tom is not the only person who believes a charm to be the best remedy for them, for the tendency of warts to suddenly disappear has led ignorant and credulous people to believe that they may be charmed away. The negroes especially have a number of "voodoo" remedies for warts.

Another pet theory that has no foundation is that the handling of frogs or toads will produce warts. As a matter of fact, it is not certain just what does cause these outgrowths on the skin. It has been noted, however, that children are most subject to them—perhaps because they bruise their hands at play; and that persons whose work may cause injury to the skin of their hands rank second. A long hanging variety sometimes occurs about the chin and neck of delicate children and on the scalp in grown persons. Warts are apt to come in numbers several at a time. They are slightly contagious; secretions from moist warts will cause others. For this reason they should be shielded by bandages.

Under the microscope a wart is seen to consist of a delicate framework of blood-vessels, supported by fibrous tissue with a scaly covering. In most instances nothing need be done about them, for they will disappear of themselves in a short time. One home remedy is to stick a heated needle through the wart, to sear the blood-vessel around which it is built. Tincture of iodine or nitrate of silver, applied with the end of a match, will burn warts off, and sometimes they are removed by the electric needle. Warts occurring later in life on the nose, lips, or other parts of the face are apt to be cancerous or tubercular and should not be neglected. If taken in time they can usually be removed by a physician with little pain or danger.

WASHINGTON, BOOKER TALIAFERRO (about 1859–1915). Born a slave, Booker T. Washington became not only a leader of his race but one of the most prominent educators in America. When the slaves were freed, this little negro lad went from the Virginia plantation which was his birthplace to Malden, W. Va. By working hard all day in a salt furnace and later in a coal mine, he helped to support the family and studied at night.

At last he was able, "by walking, begging rides both in wagons and in the cars," to travel the 500 miles to the Normal and Industrial Institute of Hampton, Va., a famous school for negroes and Indians. Here he remained three years, working as janitor for his board and education. After his graduation he taught at Malden, W. Va., and later at Hampton Institute. He proved so good a teacher that when a school for negroes was started in Tuskegee, Ala., in 1881, he was placed in charge. Here he tried to realize the same high ideals that prevailed at Hampton—to make the negro an intelligent, God-fearing, self-supporting citizen.

He opened the school, which became known as the Tuskegee Normal and Industrial Institute, in a dilapidated shanty and church, with 30 pupils and himself the only teacher, but he left it with many fine buildings, hundreds of acres of land, 1,500 students, and 185 instructors.

To the end of his life, Booker T. Washington endeavored through his work here and through his lectures and writings to uplift his people and fit them for the social and industrial conditions under which they must live, and to promote a better understanding between the white and the black races. His earnestness, his vision, and his practical ability as a reformer and educator brought him world-wide recognition. Honorary degrees were conferred upon him by Harvard and Dartmouth. The best known of his books is 'Up from Slavery', in which he tells the story of his life.

The FATHER *of the* UNITED STATES

Washington's Immortal Work as a Soldier, Statesman, and Patriot—How He Won the Revolution in the Face of Incredible Difficulties and Helped Lay the Foundation of the New Republic

WASHINGTON, GEORGE (1732–1799). The fame of George Washington is not accounted for merely by the record of his achievements. Like Lincoln, the man was infinitely greater than anything he did.

An able commander, he wrested liberty from tyranny. A statesman, he helped evolve a stable government from political chaos. A patriot, he cheerfully laid down power when he might have won a crown. Wisdom, patience, tolerance, courage, consecration to the righteous cause, animated his every act. Ingratitude, injustice, and treachery never embittered him, but served to strengthen his character. He grew in dignity and in capacity to the need of his growing responsibility and power, but he never became arrogant. Ambition and opportunity never tempted him from the narrow path of honor.

Much that has been written about the ancestry and youth of George Washington—including the "cherry tree" story—is myth or conjecture. His great-grandfather, John Washington, came over from England in 1658, and established a tobacco plantation on Bridges Creek, Westmoreland County, in Virginia. The grandson of this immigrant, Augustine Washington, was twice married, Mary Ball, his second wife, being the mother of six children, of whom the eldest was the future president.

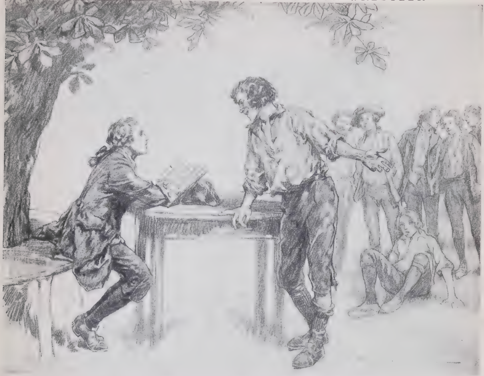
George Washington was born at Bridges Creek, the ancestral home, on Feb. 11, Old Style, or Feb. 22, New Style, 1732 (*see* Calendar). His father died when George was not quite 11 years old, and his half-brother Lawrence, who was 14 years his senior, acted as guardian and loving counselor. As head of the family Lawrence had been educated in England and had inherited the lion's share of the family property. This included a plantation on the Potomac which he christened Mount Vernon, in honor of Admiral Vernon, under whom he had served for a time in the British navy. Here his brother George spent some of the happiest years of his youth, and a few years after Lawrence's death, which occurred in 1752, this rich estate passed by inheritance into his permanent possession.

His Education and Training

The boyhood and education of young George Washington was little different from that of other Virginia lads of good family but limited means. He learned to read, write, and "cipher" in a school kept by the sexton of the parish church. But plantation affairs, hunting, fishing, and a little reading chiefly filled his days. It was to his mother, a woman of strong and devoted character, that he owed his moral and religious training. Even when her son had risen to the height of human greatness, she would only say that "George had been a good boy, and she was sure he would do his duty."

When he was 14 years old there was some talk of sending him to sea in a tobacco ship, but the plan

YOUNG GEORGE AND THE CHAMPION WRESTLER



One of the many stories told about Washington illustrating his physical strength and agility is here brought vividly before us. Young George was sitting quietly under a tree reading, while a group of boys were taking turns in pitting themselves against the local champion wrestler. Finally the champion, having thrown them one by one, stepped over to Washington and invited him to try a fall. Washington promptly accepted and quickly landed the champion in much the same attitude as the youth you see on the ground.

was abandoned. Instead he received two additional years of schooling, chiefly in mathematics, and so prepared himself for the profession of a surveyor.

Through his brother Lawrence he made the acquaintance and won the favor of Lord Thomas Fairfax, an accomplished gentleman, who held enormous grants of land in Virginia beyond the Blue Ridge. At 16 George Washington entered his employ as land surveyor. The traits of leadership and steadfastness of character which he had displayed in school and among his playmates now came out prominently. He excelled in running, wrestling, and horseback riding. His school papers had been models of neatness and accuracy. Now he had to live afoot and on horseback in the wilderness. He had helpers to direct, inferiors to govern; and he had to make out survey records so complete and accurate that they would be accepted by public officials upon which to base titles to land.

When he returned from three years of hardships and danger and exacting work in mountain and forest, he was a handsome youth of 19. He had his full height of six feet two inches. Slender at that time, he added weight with the years. In his later life his appearance was one of the greatest dignity and nobility. He had blue eyes, an abundance of brown hair, and a clear, ruddy complexion. His manner was self-controlled, his speech well considered.

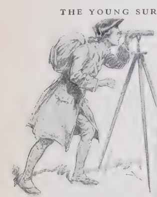
Even as a stripling he was considered a man of such remarkable gifts and experience that at 21 he was made major of the Virginia militia at a time when the colonies were preparing for war with France, and was entrusted by Governor Dinwiddie with a message to a French post, 600 miles distant.

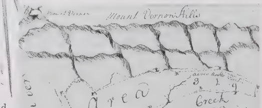
That journey, in the winter of 1753–54, was a severe test of character and capacity. It took him and his frontiersman companion across unexplored mountains, through trackless forests infested with wild beasts and hostile savages. A treacherous Indian guide attempted to assassinate him. He narrowly escaped drowning when crossing a flooded river on a rude raft. Nevertheless he accomplished his mission with success, and reported on it with the brevity and modesty which ever characterized the man.

The next summer Washington engaged in frontier skirmishing with the French, which heralded the French and Indian War. In the course of this his ill-supported little band was forced to surrender at Fort Necessity in western Pennsylvania.

When full-fledged war came, Washington was made an aide-de-camp to General Braddock. His advice as to methods employed by the Indians in border warfare was ignored, and Braddock suffered a terrible defeat. Washington was the only mounted officer in the engagement who was not killed. Two horses were shot from under him and he had four bullet holes in his coat, but he escaped unhurt. He wrote to his mother that he had been preserved by Providence for some great duty. The Indians believed he bore a charmed life.

THE YOUNG SURVEYOR





The map is a record of a survey of Mount Vernon made by Washington when he was about 14. The original is in the Department of State at Washington.

In the later stages of the war Washington was commander-in-chief of all the Virginia forces. As such, coöperating with a British expedition, he marched into the smoking ruins of Fort Duquesne in 1758 and helped rebuild it as Fort Pitt (now Pittsburgh). When at the end of the war the speaker of the Virginia House of Burgesses formally thanked him for his military services, he was too confused to speak. "Sit down, Colonel Washington," said the speaker. "Your modesty equals your valor and that surpasses the power of any language I possess."

Thus in 1758 the period of his youth came to a close. He had inherited the estate of Mount Vernon from his brother Lawrence, and he soon afterward married a charming and wealthy young widow, Mrs. Martha Dandridge Custis. He never had any children of his own, but to hers he was devoted. The education of the Custis children, the care of his large estate and the numerous slaves, his office as vestryman in the parish church, his social pleasures and his duties as a member of the House of Burgesses, which met twice a year in Williamsburg, occupied his time most agreeably for the next 15 years. In accepting the call to public duty at the close of that period, he gave up a very beautiful, complete, and endearing domestic life for which no honors ever compensated.

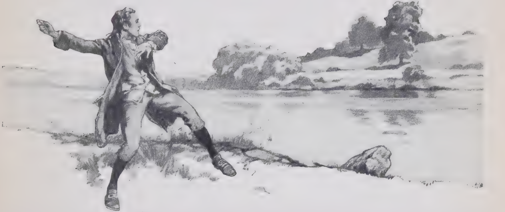
In 1774 Washington was chosen a delegate to the first Continental Congress. Many remarkable men were there—the Adamses, Franklin, Jefferson, and others—but Patrick Henry said: "If you speak of solid information and sound judgment, Colonel Washington is unquestionably the greatest man on the floor." When the appointment as commander-in-chief of the Continental forces was offered to him after the battle of Lexington and Concord, he replied that he was deeply honored, but honestly felt that he lacked capacity for so great a task. Throughout he refused pay for his services.

Washington arrived in Boston early in July 1775 after the battle of Bunker Hill. Beginning with an army of 14,000 untrained men, with few supplies, he had not only to attend to his military duties, but to serve 14 masters—Congress and each of the 13 colonies—and to persuade all of them to support his operations and to furnish him with men and supplies. It was an experience to make a great man, to break a weak one. When, in March 1776, the British were driven out of Boston, Washington had become a statesman and a military commander of the first rank.

But Washington's fame does not rest on the battles he fought. The greatest battle of the Revolution—probably the decisive conflict that turned the tide of war—was the battle of Saratoga, at which Washington was not present. Nevertheless Washington's retreat across New Jersey; the manner in which he turned and struck the pursuing enemy at Trenton and Princeton and then established himself on the heights of Morristown, overlooking New York; and the vigorous resistance to British occupation of Philadelphia all marked him as a competent military leader. That record was crowned by the terrible winter of 1777–78 at Valley Forge, when in spite of the misery of his soldiers, the clamor of the people tired of war, the delays of a fugitive Congress, and the intrigues to have him superseded, he held his position and kept his starving army to its task.

When, on the news of the French alliance, in 1778, Philadelphia was evacuated to unite the two British armies in New York, Washington chased the enemy across New Jersey and shut them into New York. There he remained, watching, waiting, on the Hudson, while the British carried the war to the south. They captured Savannah and Charleston and entrenched at Yorktown, in Virginia. Then, feigning an attack on the weak garrison in New York, Washington made a forced march to the Potomac, the French fleet appearing simultaneously in Chesapeake Bay. Three weeks later Cornwallis surrendered and the actual fighting of the Revolution was over.

WASHINGTON THROWING A STONE ACROSS THE RAPPAHANNOCK



All boys throw stones about more or less in an idle sort of a way, but it was characteristic of Washington that he made it a point to excel even in so trifling a matter. This picture illustrates the story of his throwing a stone clear across the Rappahannock. Another story relates how he stood almost under the famous Natural Bridge of Virginia and threw a stone which landed on top of the bridge.

If Washington had died immediately after this event, his fame as the liberator of his country would have been secure. His services in time of peace were even greater and increased his title to fame.

When officers of the army suggested that he use force to extort from Congress their just dues and overturn that inefficient government, he sternly rebuked them. Like another Cincinnatus, he retired in 1783, to Mount Vernon—as he hoped, to private life. But it was not to be. Instinctively the colonies trusted him and believed in his honesty, wisdom, and disinterestedness as they did in no other man of that time. So when the movement for "forming a more perfect union" began, he could not stand idly by.

No one saw more clearly than did Washington, in the critical period from 1783 to 1789, the dangers which beset the new nation, and it was largely owing to his efforts that a convention finally met in Philadelphia in May 1787 to revise the Articles of Confederation. In this convention Washington's influence was of prime importance. On the first day he was called to the chair by a unanimous vote, and during the four months' session his hand guided the work of one of the most notable assemblies ever held.

After the convention had finished its task, Washington continued to work for the ratification of the new Constitution by the states. He regarded it as the best which could be had at that time, and it was largely due to the fact that he approved of the document that the people were finally induced to accept it, and it became a living reality.

A leading historian has said that "the office of president was cut to Washington's measure"; and it was to Washington, as first president (1789–1797), that the people committed the task of putting into operation the new government.

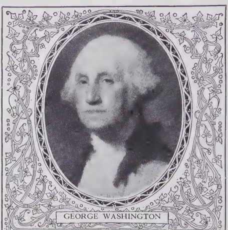
The Constitution provided merely the plans for the framework of the government. That framework itself was yet to be reared, and it depended upon the men in power whether it should be a strong or a weak structure. The division of parties over the adoption of the Constitution was continued over its setting up and operation. One party, led by Alexander Hamilton, favored a strong national government, with weak state governments. The other, led by Thomas Jefferson, desired a weak central government and strong state organizations. Washington included both Hamilton and Jefferson in his cabinet. But on most points he supported the policies of Hamilton, and thus saw to it that the new government did not have the weaknesses which made the government under the Articles of Confederation a laughing stock.

As secretary of the treasury, Hamilton worked out a financial system designed to put the affairs of the new nation on a firm footing. The cornerstone of his plan was the funding of the national debt and the assumption by the central government of the outstanding state debts. There was strong opposition to this program, especially the second part. Hamilton and his supporters finally carried the day by a bargain which placed the new capital (after 1800) on its present site on the Potomac River, giving their support to the friends of a Southern capital in return for votes for the assumption measure. Disagreements arose also on the setting up of a United States bank, and on establishing a mildly protective tariff. Here also the party led by Hamilton was supported by Washington's influence, and the first United States bank was established and the first tariff law passed.

The failure of the "Whiskey Rebellion" in western Pennsylvania further contributed to the national prestige. The distillers in this district openly resisted the collectors of the federal tax on distilled liquors, but serious trouble was averted by Washington's prompt action in sending troops to Pittsburgh and his tact in negotiating with the leaders.

One of the first acts of Congress was the establishment of federal district and circuit courts in addition to the Supreme Court provided by the Constitution. Upon the President rested the responsibility of making the right appointments to the bench. This was a serious task, for upon the ability of these first judges depended much of the success of the judiciary. He wisely chose John Jay for chief justice and drew from the distinguished men on the state benches to fill the other positions.

The bitterest differences of opinion during Washington's term arose over the part which the government should play in a new conflict which was raging between England and France, growing out of the French Revolution which had overthrown the monarchy and in Washington's second administration was desperately maintaining itself by a policy of bloody terrorism. Hamilton's party sympathized with England, while the party led by Jefferson was friendly to France. Here again Washington made his moderating influence felt.



GEORGE WASHINGTON

WASHINGTON'S ADMINISTRATIONS

1789-1797

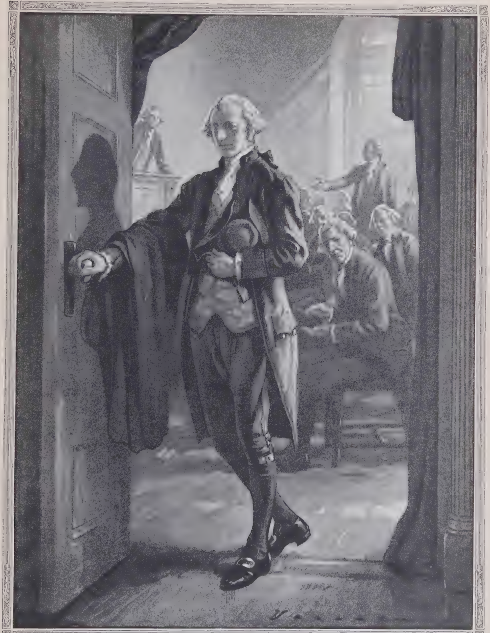
Federal Executive Departments and Judiciary System organized.
North Carolina ratifies Constitution (1789), Rhode Island (1790).
Mint established at Philadelphia and System of Coinage adopted.
National Debt funded and State Debts assumed by National Government.
Site on Potomac chosen for National Capital.
First Federal Census; Population, 3,929,214 (1790).
Indian War in Northwest Territory (1790–95).
First National Bank chartered (1791).
First Ten Amendments ("Bill of Rights") adopted (1791).
Vermont admitted (1791), Kentucky (1792), Tennessee (1796).
Republican (later Democratic) and Federalist Parties appear.
Washington and Adams reëlected (1792).
Eli Whitney invents Cotton Gin (1793).
Washington issues Neutrality Proclamation (1793).
"Whiskey Rebellion" in Pennsylvania suppressed.
"Jay's Treaty" of Amity, Commerce, and Navigation concluded with Great Britain (1794).
Washington's Farewell Address (1796).

By his famous proclamation declaring the neutrality of the United States, he not only kept the country out of the war, but he originated the policy of holding aloof from European wars and politics which was followed until the United States was forced into the World War of 1914–18.

Washington had been reëlected president for the term beginning in 1793. When he was asked to serve a third time, however, he refused, thus establishing a precedent against a third term which has continued to be observed. The Farewell Address which he issued announcing his intended retirement is one of the greatest state papers ever put forth for the guidance of the American people.

Not merely in what he did, but also in the things he refrained from doing, Washington earned that gratitude which leads men even today to style him "the Father of his Country." Nevertheless he was not spared the violent party abuse which so often is the lot of the faithful servant of a democracy. His political foes spoke of him as the "stepfather of his country," and ridiculed his manners as "aping monarchy." On the day he left the presidential chair, an opposition newspaper in Philadelphia published a bitter attack which, among other violent charges, contained the following astounding words: "This day ought to be a day of jubilee in the United States. If ever a nation was debauched by a man, the American nation has been debauched by Washington. If ever a nation has been deceived by a man, the American nation has been deceived by Washington. Let his conduct, then, be an example to future ages; let it serve to be a warning that no man may be an idol; let the history of the Federal government instruct mankind that the mask of patriotism may be worn to conceal the foulest designs against the liberties of the people."

LEAVING THE HALL TO AWAIT THE VOTE



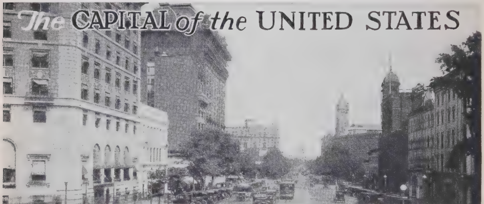
Fully conscious of the great difficulties and responsibilities of the position, Washington left the hall of the Continental Congress while the vote was taken on the question of making him commander-in-chief. When he was suggested for this momentous duty, he replied that he was deeply honored but that he lacked the capacity for so great a task. But the members of the Congress proved that they had full confidence in his ability. You can see by Washington's expression, as the artist has portrayed him here, how keenly he realized the magnitude of the trust which was to be committed to him.

It is difficult for us to realize that any party could be so carried away as to attack in this manner a man whose character is now universally venerated. This partisan abuse, however, hurt only the authors of it, who are now forgotten, while the name of the man whom they defamed, like the name of Lincoln, stands far above that of any other man of his time.

Following his retirement Washington lived the life he loved best, that of a planter "amid the mild concerns of ordinary life" at Mount Vernon. He now found leisure to enjoy the society of his family and the simple pleasures of plantation life that had so long been denied him. Yet strong ties held him close to the heart of his country. Men from far and near came to consult him on questions of public importance, while no foreigner counted his trip to America complete without a pilgrimage to Mount Vernon. This period of well-earned enjoyment was all too short. In less than three years, on Dec. 12, 1799, Washington contracted acute laryngitis as the result of a long ride on horseback in a snow storm. Two days later he was dead. In accordance with his wishes he was buried in the little family vault in the hillside at Mount Vernon, overlooking the Potomac River. When the news of his death reached Europe, the mourning was almost as widespread as it had been in the United States, for he was regarded abroad, as a statesman of world-wide influence.

John Marshall, later chief justice, in moving the resolution of national grief in Congress, quoted words which truly sum up Washington's position in American history: "First in war, first in peace, first in the hearts of his countrymen." The final word as to Washington was perhaps said by John Richard Green, the historian of the English people, when he characterized Washington as "the noblest figure that ever stood in the forefront of a nation's life." Tennyson's eulogy of Wellington applies even better to Washington: "Whatever records leap to light, *he* never shall be shamed.".

The CAPITAL of the UNITED STATES



View of Pennsylvania Avenue, Looking toward the Capitol

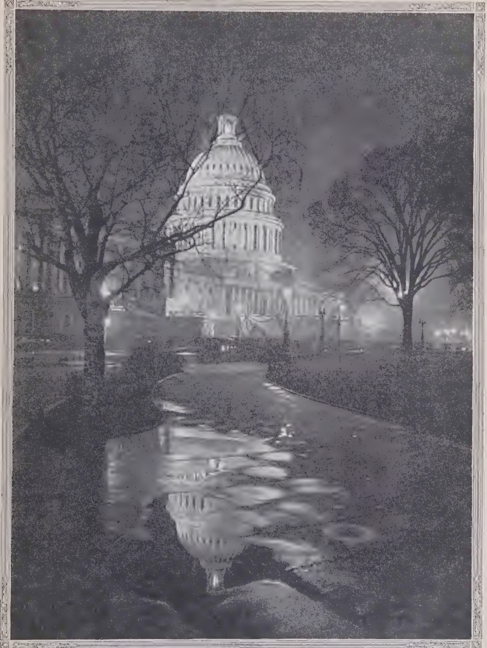
WASHINGTON, D. C. About noon on March 29, 1791, a group of six men, bundled in great coats, for the winds were bitter, stood gazing over a "wilderness" on the hills above the Potomac River. Now and then they pointed into the distance and conversed intently. One was taller and sterner of features than the rest. This was President George Washington who had come from New York, then the seat of government, to assist the surveyors and commissioners in fixing definitely the boundaries of the new "Federal District" provided for in an act of Congress the year before. The location of the district on the Potomac was the result of a bargain, by which Northern leaders had waived their objection to a site in the South in return for enough votes from Southern congressmen to secure the adoption of Alexander Hamilton's important measure by which the Federal government assumed the state debts.

Major Pierre Charles L'Enfant, a French engineer who had fought in the American Revolution, prepared the plans for the new city, which was christened "Washington." On Sept. 18, 1793, the cornerstone of the Capitol building was laid, and in 1800 the seat of government was transferred there.

The British in the War of 1812 set fire to Washington (Aug. 24, 1814), and destroyed the Capitol and left the president's house in ruins. These and other public buildings were quickly rebuilt, and Washington today follows in its arrangement of streets and in the location of its principal government buildings the plans made by L'Enfant. (For map *see* page 2162.)

The Capitol, the "heart of the nation," stands in the center of the city, surrounded by beautiful park-like grounds. Stretching out its great white mass of sandstone and marble for 750 feet, and crowned

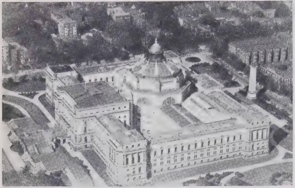
THE UNITED STATES CAPITOL AT NIGHT



The magnificent Capitol at Washington, always so impressive in its majesty and beauty, is never more striking than when seen at night brilliantly illuminated, as it is here. With its immense dome, its stately columns, and the noble dignity of its style and proportions, it forms a fitting symbol of the nation's greatness.

by an immense dome on which stands a statue of Freedom rearing its helmeted head 285 feet above the ground, this is one of the most imposing buildings in the world. As one approaches it from the east, great flights of steps seem to flow from beneath the huge columns that mark its three giant porticoes. To the left is the wing housing the House of Representatives; to the right, the wing in which are the Senate chambers. From the portico in the center two big bronze doors, with panels illustrating the life of Christopher Columbus, swing back and lead into the rotunda 97 feet in diameter, from which you gaze up 180 feet into the dome. Its walls are decorated with paintings and statues representing important scenes and figures in American history. Here many of the presidents of the United States were inaugurated in office.

THE HOUSE OF THREE MILLION BOOKS



If you had been aboard a certain army airplane passing over Washington, one day, you would have seen this view of the great Congressional Library Building. The style of architecture is Italian Renaissance. The walls of the building enclose four courts and a central rotunda surmounted by a dome. This splendid structure houses one of the world's greatest collections of books.

To the right of the rotunda are the rooms of the United States Supreme Court; to the left is Statuary Hall, in which are placed statues of leading citizens from every state in the Union. This was formerly the Hall of Representatives, and its walls have echoed to the stirring speeches of Webster and Clay, Adams and Calhoun.

As you ascend the spiral staircase to the crowning cupola of the great dome, Washington spreads out before you in impressive panorama. What at first appears to be a maze of criss-cross thoroughfares stands out suddenly in orderly arrangement. You see that the general plan is composed of streets running at right angles to each other, and that these are intersected by broad avenues, sweeping diagonally from one corner of the city to the other. The principal ones converge like the spokes of a wheel below you at the Capitol grounds, while farther out are other focal centers. Wherever two of these great tree-lined avenues meet, small circles and squares have sprung up, blazing green in the sunlight.

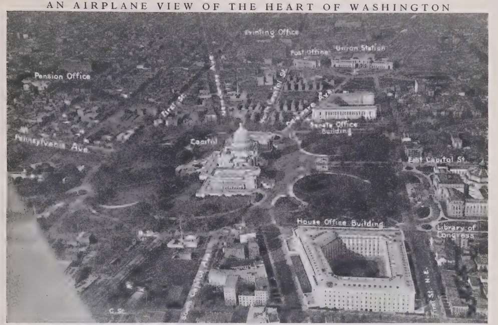
Facing eastward and looking down almost beneath your feet you see on each side of Capitol Square the buildings erected for the private offices of the members of Congress, the one on the left for the senators, the one on the right for the representatives.

Ahead looms the massive bulk of the Library of Congress, considered the finest library building in the world and containing over 3,500,000 books. This is Uncle Sam's reading room, where anyone may enter and have the stored up knowledge of the world at his beck and call. Two copies of every book copyrighted under the laws of the United States must be deposited free in the Library of Congress, and here also are gathered books by purchase from all over the world and some of the nation's most important historical documents. The walls and ceilings are splendidly decorated with mural paintings, all by eminent American artists, representing the arts, sciences, history and mythology, and the march of civilization. Bas-reliefs on the three great bronze

A FAMOUS HOME OF SCIENCE

This is the famous Smithsonian Institution, founded under a bequest of James Smithson "for the increase and diffusion of knowledge among men." The statue in front is of Joseph Henry, the first secretary of the Institution.

AN AIRPLANE VIEW OF THE HEART OF WASHINGTON



What a blissful experience it would be for Major L'Enfant, if he could come back to life for a day and take an airplane flight over the city of his dreams! Such a view as this you are now looking at would show him the realization of his fondest hopes—a national capital without a peer for the symmetry and harmony of its design, following out, with little change, his original plans.

doors by Olin Warner and Frederick MacMonnies symbolize "Tradition," "Writing," and "Printing." (For interior view, *see* Library.)

It is from the other side of the cupola, however, that the best view of official Washington presents itself. From here your eye follows the broad sweep of Pennsylvania Avenue, the principal street of the city, running diagonally toward the northwest. A little over a mile away, the Treasury building halts your gaze. This huge white structure, flanked with massive columns like a Greek temple, is Uncle Sam's purse. Upon the millions and millions of dollars in gold stored in its great vaults rests the whole financial structure of the nation.

The White Home of the Presidents

If you could move this treasure house to one side, you would see lying in the midst of a great lawn dotted with trees the White House in all its stately simplicity. This was the first public building erected at the capital. Washington himself selected the site and laid the corner-stone on Oct. 13, 1792, and lived to see the building completed, though he never occupied it. John Adams in his closing year of office was the first president to live here. The British burned the building in 1814, leaving only the walls standing. To obliterate the marks of the fire when it was rebuilt these walls were painted white, giving the mansion its name. The White House is rich in historic relics, portraits of presidents' wives, gifts from foreign countries, and contributions of rare fixtures and furnishings left by successive occupants. The Executive Offices, in which the president transacts business, are now housed in a low stone building adjoining the White House to the west.

South of the White House are the slopes of lawn where Washington children go for their egg-rolling on Easter Monday. This broad stretch of green is flanked on the west by a group of notable buildings, the finest in Washington. There are the Corcoran Art Gallery with its fine collection; the Red Cross Building, the American headquarters of that organization; Continental Hall, erected by the daughters of the American Revolution and other patriotic societies; and the Pan-American Union, established to foster friendly relations among the 21 American republics.

To the north of the White House is Lafayette Square, beautiful with trees and flowers, and adorned with memorials to foreign soldiers who aided the cause of American independence.

Beyond the White House on the west is the five-story building which houses the State and War departments. It is a huge structure, covering four and a half acres. Before the World War the Navy Department also occupied this building, but it is now housed in a new building in Potomac Park.

More impressive even than the view down Pennsylvania Avenue is the vista westward from the Capitol down the broad green stretches of the Mall. This is a park, the width of four blocks, which extends to the banks of the Potomac and in which are an imposing array of public buildings—the National Museum, Smithsonian Institution, the Department of Agriculture, etc. In the distance rises the great white shaft of the Washington monument, 555 feet high. This was begun in 1848 and completed in 1884 at a cost of more than a million dollars. An elevator and an iron stairway of 900 steps lead up to the apex, which is capped with an aluminum point.

The Smithsonian Institution and the old and new National Museums form a center of scientific knowledge in the United States. The first of these is named from James Smithson, an Englishman who in 1829 bequeathed his fortune to the United States to be devoted to "the increase and diffusion of knowledge among men." Accordingly the Smithsonian Institution, established by Congress in 1846, undertakes to encourage research, supervise trips of exploration, conduct investigations in natural history, geology, ethnology, archaeology, and other scientific subjects, gather and classify rare and interesting specimens, and publish reports of discoveries. Its immense collections of plants and animals, of minerals, of historical documents and relics, etc., are housed in the two museum buildings, which are under the direction of the board of regents of the institution. Scientists from all parts of the world come here to study at this rich mine of learning.

The Army Medical Museum and the quarters of the Fish Commission, which has charge of the breeding and hatching of millions of tiny fish with which the streams and lakes of the country are stocked each year, are also on the Mall.

Potomac Park and the Lincoln Memorial

Looking southwest from the Capitol, the eye meets the long sweep of Potomac Park, which stretches along the river for more than two miles. A tidal reservoir with a bathing beach lies midway in the park, while its southeastern part is an island separated from the mainland by the Washington channel, with its long lines of docks and piers. At the upper end of Potomac Park stands the Lincoln Memorial, a great building in the form of a Greek temple with white marble columns 40 feet high (for picture, *see* page 2011). In Potomac Park and near by were located many of the vast numbers of emergency buildings that were constructed during the World War to house the overflow of the war-working department of the government. Although most of these were intended to be only temporary, the Navy Department, toward the foot of 17th Street, was given a permanent fireproof structure with the plain practical lines of a modern office building.

On the edge of Potomac Park, southeast of the Washington Monument, is the Bureau of Engraving and Printing, where paper money, government bonds, postage and revenue stamps, etc., are printed. The public is allowed to see all the operations except the actual engraving of the plates, which is done in secret for fear of encouraging counterfeiting. The government printing office, in which are printed the *Congressional Record* and other publications produced from type, is on North Capitol Street in another quarter of the city.

The College of the Art of War

South of the Capitol, at the point where the Anacostia River flows into the Potomac, are the Washington barracks and the United States War College, where the general staff of the army is housed, and where officers who have distinguished themselves in the service attend classes in advanced military science. About a mile up the Anacostia River is the big United States Navy Yard, where great lathes turn out monster guns for warships. Here also cannon captured in the various American wars are on exhibit. A willow tree which shades the naval museum here was grown from a slip taken from a tree over Napoleon's old grave on the island of St. Helena.

On 10th Street in the northwest section is the old Ford's Theater building in which Lincoln was shot, and across the way is a Lincoln museum, established in the house in which Lincoln died. Near by is the Patent Office, which houses the Department of the Interior. The General Land Office, the Pension Office, and the City Hall are also in this quarter. The Postoffice Department occupies a stone building on the left-hand side of Pennsylvania Avenue, as you go toward the White House. The city postoffice, which is a beautiful structure of white marble, is near the new Union Station on North Capitol Avenue.

One of the most striking sights from the Capitol cupola is the immense bulk of the Union Station looming up to the north. It is built of granite in a series of great arches and vaults. The passenger concourse is the largest room in the world under one roof, and an army of 50,000 men could stand on its floor. The railways from the south enter the station through twin tunnels beneath Capitol Hill.

Gazing out toward the city limits, you see in the northwest the heights of Georgetown, beyond Rock Creek. This former suburb was founded before Washington itself, but today it forms a part of the city; it was named for George II. It is the seat of Georgetown University, the oldest Jesuit college in the United States, and of the Convent of the Visitation, a large school for girls.

On an eminence north of Georgetown stands the United States Naval Observatory, through whose great telescope the observations are made by which official time is regulated and telegraphed hourly to all parts of the country.

Still farther to the north, adjoining beautiful Rock Creek Park, is the Zoölogical Park. The United States Soldiers' Home, with its immense grounds, marked by a great white tower, lies some distance to the east of the zoo. This home is maintained for

"THE GREAT WHITE SHAFT" AS IT LOOKS AT SUNSET

We have seen how the Capitol Building looks at night under the illumination of the electric lights. Here we see how the great white 555-foot shaft of the Washington Monument looks at dusk against a background of clouds reflecting the sun's last rays.

men who have served 20 years or more in the army, or who have been disabled by wounds or disease while in the service. Beyond the grounds of the home is the National Cemetery, where 7,800 veterans lie buried. Closer in is Howard University, famous for its work in the higher education of the colored people, while farther out is the Catholic University of America with its group of affiliated colleges. Northeast of the Capitol are the wide grounds and numerous buildings of Gallaudet College, a department of the Columbia Institution for the Deaf (founded 1857)

Washington during the World War

It would be impossible to give a complete list of the numerous other points of interest in this great city—the many museums, libraries, monuments, the scores of government bureaus, the clubs, the schools, the foundations such as the Carnegie Institution for scientific research, the embassies and legations of foreign countries, and a host of others. The city, which even in normal times has grown very rapidly, received during the World War a tremendous impetus. Thousands of men and women flocked there from all parts of the United States; buildings were put up on every available inch of ground to house the influx of government employees and others engaged in war work. Nowhere could be found a more picturesque sight than the Washington streets presented during those stirring days. Uniforms were everywhere; the olive drab of the army mingled with the blue of the navy; foreign officers of all the Allied countries, war nurses, members of scores of relief organizations in special costumes—all united in giving a vivid color to the busy crowds.

But Washington is a very confusing city for the newcomer or casual visitor. The whole city is divided into four quarters by North, East, and South Capitol streets, and the line of public parks and grounds stretching westward from the Capitol to the Potomac. These quarters are named, respectively, Northeast (N.E.), Northwest (N.W.), Southeast (S.E.), and Southwest (S.W.). All the diagonal avenues are named—like Pennsylvania Avenue—after states of the Union. The north-and-south streets are numbered, and the east-and-west streets are named with the letters of the alphabet, in each case starting with the central lines of division and working outward. Thus there are two "G" streets and two "14th" streets, widely separated from each other. This makes necessary great care in directing a letter to indicate in which quarter the address lies. The Northwest section is much the largest and contains most of the important government buildings, the centers of business, and the fashionable residences.

Historic Memories in the Nation's Capital

A characteristic feature of the city is the existence side by side of the old and the new—of the plain red brick residences and stone buildings of Lincoln's day, alongside the splendid structures of the present; and of blocks of negro homes interspersed amid the fashionable residences of their white neighbors.

Washington is not an industrial city and its manufactures are comparatively few. Above the city is a series of beautiful falls and rapids in the Potomac, but the Chesapeake and Ohio Canal gives barge transportation as far as Cumberland. Below Washington the river is navigable and boats may be taken for Mt. Vernon, Norfolk, and Baltimore.

The District of Columbia, whose official boundaries are today the same as those of the city, originally included in its "ten miles square" area 30 square miles on the Virginia side of the Potomac River. It was found that this land would not be needed, so it was given back to Virginia in 1846, leaving the district with an area of 60 square miles, ten miles of which is water surface. The city of Alexandria, the Arlington National Cemetery, and Fort Myer thus stand today on Virginia soil.

The government of the district is in the hands of three commissioners appointed by the president with the approval of the senate. The expenses of administration are divided between the citizens of Washington and the Federal government. These citizens have no vote, for it has been found wise to remove from the national capital all questions of municipal politics. Justice is administered by special district courts under laws passed by Congress. In 1871 the experiment was made of constituting the district into a territory, with a governor and legislature, and delegates to Congress, but great political corruption sprang up, and in 1874 the plan was abandoned. The numerous government officials and employees, however, may retain if they desire the right to vote in their home states. The climate is mild in winter, but is subject to violent changes. Sometimes the damp summer heat becomes oppressive. Population of Washington, 438,000.

The "EVERGREEN STATE", *A* PARADISE *of* BEAUTY

Mirror Lake with the Snow-Clad Peak of Mount Rainier Rising in the Distance

WASHINGTON, STATE OF. Lying in the extreme northwestern corner of the United States, Washington is the twin state of Oregon, and in fact was, until 1853, a part of "Old Oregon." Not until 1863 did it take its present form, between Idaho and the Pacific Ocean, British Columbia and the Columbia River.

Extent.—East to west, greatest distance, 360 miles; north to south, 240 miles. Area, about 69,127 square miles. Population (1920 census), 1,356,621.

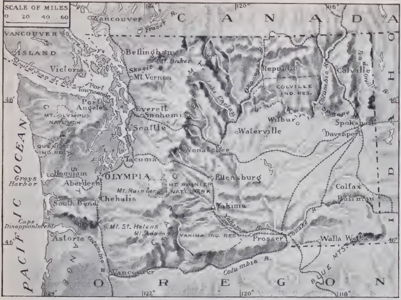
Physical Features.—Comparatively regular Pacific coast line broken by Willapa Bay and Grays Harbor; Puget Sound extending halfway down the state between the Olympic Mountains (northern part of coast range) and the Cascade Mountains (Mt. Rainier, 14,408 feet) which cut the state into east and west Washington; Okanogan Highlands stretching east from the Cascades to the Idaho border and sloping to the Columbia, which forms much of the southern boundary. Principal rivers: Columbia and its tributaries (Snake, Okanogan, and Spokane); Skagit, Skykomish, and Nisqually flowing into the Sound.

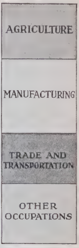
Products.—Wheat, oats, barley, hay, potatoes, apples, peaches, pears, etc.; cattle and dairy products, sheep and wool, hogs, horses; salmon and other fish; coal, cement, clay products, etc.; lumber and timber and their manufactures (shingles, sash, doors, furniture, paper and pulp); flour and meal, meat products, canned fruits and vegetables, foundry and machine-shop products, ships and boats.

Chief Cities.—Seattle (320,000), Spokane (105,000), Tacoma (100,000), Everett and Bellingham (over 25,000), Olympia (capital, 10,000).

Like Oregon, Washington is divided from north to south by the high and broad wall of the Cascades. The pleasant lands between the mountains and the ocean are breathed upon by cool breezes from the ocean in summer and warm winds in winter, so that flowers bloom every month of the year. The moisture borne by the Pacific winds is precipitated by the cold mountain ranges, giving the western section one of the heaviest rainfalls in the world. Over the mountains to the east it is a different story, with winter snows and blazing summer sun, and a semi-arid climate requiring irrigation to raise crops. Along the Pacific, a few miles inland, runs the Coast Range which rises in the north into the rugged group known as the Olympic Mountains. Between these and the

WASHINGTON'S VARIED FACE—SEABOARD, BAY, MOUNTAINS, AND PLAINS

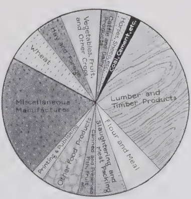

SCALE OF MILES
0 20 40 60
CANADA
OREGON
IDAHO
PACIFIC OCEAN
Vancouver
Fraser R.
VANCOUVER ISLAND
Victoria
Strait of Juan de Fuca
Port Townsend
Port Angeles
MT. OLYMPUS NAT'L MON.
Bellingham
Mt. Baker
Skagit R.
Mt. Vernon
Everett
Snohomish
Seattle
QUINAULT IND. RES.
Hoquiam
Grays Harbor
Aberdeen
OLYMPIA
Tacoma
Wenatchee
Lake Chelan
Okanogan R.
Republic
Colville
COLVILLE IND. RES.
Columbia R.
Pend Oreille R.
Spokane R.
Wilbur
Spokane
Davenport
Waterville
Ellensburg
Mt. Rainier
MT. RAINIER NAT'L PARK
Chehalis
South Bend
Cape Disappointment
Astoria
Mt. St. Helens
Mt. Adams
YAKIMA IND. RES.
Yakima
Yakima R.
Prosser
Snake R.
Colfax
Pullman
Walla Walla
BLUE MTS.
Columbia R.
Vancouver
124°
122°
120°
118°
48°
46°



Note the varied surface of this state, with the wall of the Cascades dividing it. Above, the occupations of the people are compared.

lofty Cascades is the bright tangle of bays and inlets, called Puget Sound, forming one of the finest harbors in the world. This network of water runs halfway down the state; in its most fertile valley and along its shores most of the large cities, Seattle, Tacoma, and Olympia (the capital), are located. The magnificent Columbia River flows south through the eastern half of the state in a sweeping curve known as the Big Bend; then after receiving the waters of the great Snake River from Idaho, it bends sharply to the west and flows to the Pacific along the state's southern boundary, cutting a gorge of matchless grandeur through the Cascades (*see* Columbia River).

Many snowy shining mountain peaks rise on the Cascade ridge, among them the ancient volcanoes of Mount Baker, Glacier Peak, Mount Adams, smooth white Mount St. Helens, and the pride of Washington, Mount Rainier, or Mount Tacoma as it is sometimes called from the name given it by the Indians, meaning "The Mountain that was God." About this icy majestic peak (14,408 feet) Mount Rainier National Park has been reserved, a beauty spot of 324 square miles. Here are lacy waterfalls, the white careering waters of mountain streams, polished lakes, great mysterious glaciers, and forests of tall fluffy humming pines and cedars that were seedlings long before Columbus began to dream of a world that is round and to push daringly across the sea.



The manifold sources from which Washington draws its wealth are here graphically represented.

These wide forests of Douglas fir, red fir, white and yellow pine, hemlock, and tamarack extend indeed over most of the tumbled surface of Washington, where they have not crashed before the lumberman's saw, and give the state its popular name, "the Evergreen State." The lumber industry is larger than any other in the state, in the value of its output. But naturally such a state as Washington, with a variety of climates and soils wide enough to supply a nation, does not limit its energies to any one industry. In the rich eastern plains the farmers raise great crops of wheat, oats, barley, and hay, and in the moist western basin and in irrigated valleys east of the Cascades they lay out broad acres of fruit trees, apples, plums, prunes, and cherries. Fine herds of cattle and other live stock go to market from the grassy plateaus, or supply milk for the growing dairy industry; and the fish leaping in the streams, especially the salmon, have made Washington one of the four greatest states in the value of their fisheries. Cod, halibut, mackerel, and herring are also taken in abundance. From the rocky hillsides come granite, limestone, gold, silver, copper, iron, and lead; and great coal fields in the Puget Sound basin furnish coal to all the Pacific states.

CAPITOL OF THE "EVERGREEN STATE"

Washington's stately new Capitol at Olympia, completed in 1927, is built of native stone. Marble from many lands adorns the interior.

With these raw materials, and with so many mountain torrents and waterfalls to supply power for factories (the state is said to have nearly one-fifth of the country's potential hydroelectric power), Washington sees every year more and more manufactures turned out, especially of dressed and manufactured lumber, in which it ranks first of all the states. Flour and grist-mill manufactures also rank high, much of their product being exported to oriental markets. Iron and steel are being produced in ever-growing quantities. Tacoma and Seattle are the ports for an extensive trade with foreign lands and with the Philippines, Hawaii, and Alaska. Much of this is carried in ships built in Washington shipyards from the unsurpassed Washington timber. Ocean vessels ply the waters of Puget Sound to the very doors of Seattle and Tacoma, and by digging out a few canals hundreds of miles of water front have been made.

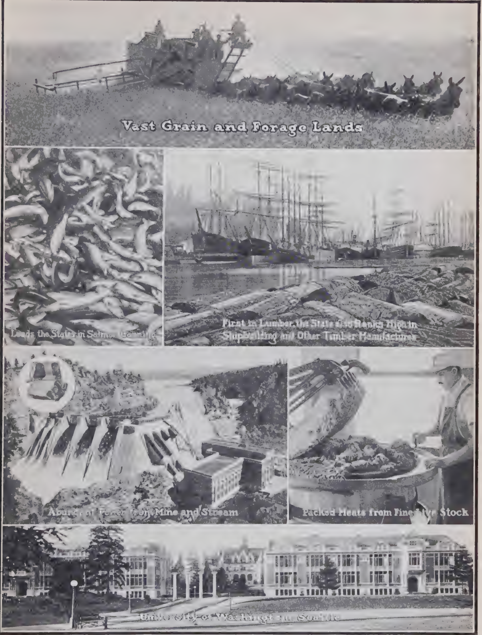
Yet Washington is still just in the beginning of things. Her population is but a handful compared to the people she could support. Although there are a surprising number of fine buildings, good schools, and excellent roads, there are also many acres of the "logged-off" land of the settler, that is, land from which the trees have been cut but from which the stumps have not yet been removed.

The early history of Washington is the same as that of Oregon, for they were both part of that Oregon territory the title to which was settled by treaty with Great Britain in 1846 (*see* Oregon). Washington was separated from Oregon by act of Congress March 2, 1853, and for 36 years was governed as Washington Territory. During the late '50's occurred numerous Indian wars and wrangles, in which Lieut. Philip Sheridan, who was to be the famous Sheridan of the Civil War, was an active figure. About 1855 also there came up the question of whether Great Britain or the United States owned San Juan Island, lying between the mainland and

IN THE YAKIMA VALLEY—A MAN-MADE PARADISE

The wonders that can be accomplished by irrigation are shown in the beautiful Yakima Valley, east of the Cascades in the southern part of Washington. The greatest irrigation projects in the state have checkered the country with orchards, farms, and gardens, where a few years ago sage brush and bunch grass struggled for existence.

TYPICAL SCENES IN BUSY WASHINGTON


Vast Grain and Forage Lands
Leads the States in Salmon Canning
First in Lumber, the State also Ranks High in Shipbuilding and Other Timber Manufactures
Abundant Power from Mine and Stream
Packed Meats from Fine Live Stock
University of Washington, Seattle

Field, forest, mountain, and sea, all contribute their share to the growth and prosperity of Washington. Nearly one-tenth of the total area is given over to the cultivation of hay, wheat, and other grains. The mountainous sections have rapid streams which supply water power, and they also have coal. Washington is the only Pacific state whose coal beds are important. The sea yields millions of dollars worth of fish, and in the catching and canning of salmon, Washington leads all the states. It also leads in the yearly cut of rough lumber, and it makes about three-fifths of all the shingles made in the United States.

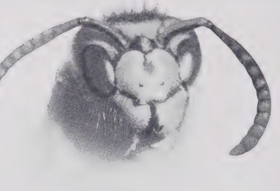
Vancouver Island. The island had been settled by both American and British pioneers, and one day a British pig broke pen, made havoc in an American potato patch, and was promptly shot. Then came the question of whether the matter of the pig was to be heard in an American or a British court. About the same time a vigorous American tax collector collected certain British sheep rather forcibly in payment of tax claims. These barnyard perplexities kindled a serious dispute between the two countries which was referred to arbitration in 1872. As a result San Juan Island was given to the United States and is part of the state of Washington.

During the Civil War the distant state of Washington mustered a gallant band of volunteers. In 1879 the territory first sought to become a state, but admission to the Union was refused. The period from that time until 1889, when she did gain statehood, is known as "the turbulent decade," because of the disturbances and riots crowded into these ten years. The year 1889 was "the year of fires," for the cities of Seattle, Ellensburg, Spokane, and Vancouver, one after the other, lost their entire business districts by fires.

But the period also saw great strides of progress. In 1883 the Northern Pacific Railroad was completed joining far-off Washington with the east. Only two other railroads had operated in the state before this, one of them the Walla Walla road completed in 1875. This was a remarkable affair, with wooden rails on which strips of rawhide were tacked; unfortunately, during the winter the hungry coyotes would nibble off all the rawhide. It is a far cry from that rickety railroad and those hard laborious days to the comfort and prosperity of the present bustling state, with its lively port, Seattle, from which was launched Dewey's flagship of Manila Bay fame, and also many another fine vessel in the World War of 1914–18.

OUR CLEVER FRIENDS—THE WASPS

Paper-Makers, Masons, and Carpenters



How a Wasp's Face Looks under the Magnifying Glass

WASPS. Most people think of wasps simply as annoying creatures with bad tempers and sharp stings, and until quite recently no one ever bothered about them much except when stung. And this unpleasant habit, together with the fact that they sometimes feed on ripe fruit, was about the extent of our popular knowledge. Even the encyclopedias, after they had given a dry description of the wasp's body and a few of its general habits, usually ended their articles with advice on the best way of killing wasps.

Fortunately in recent years the true student has been going into the gardens and fields and watching the *living* insect at his daily work and trying to get the insect's "point of view." This has been a great benefit to the much misunderstood wasps, which are not only among the wisest of all insects, but also in many cases true friends of men.

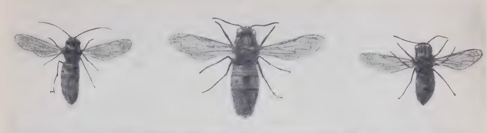
Belonging to the same order of insects as the bees and ants, the wasps themselves may be divided into two groups—the "social" wasps and the "solitary" wasps. The former, including the hornets and yellow-jackets, live very much like bees, with queens and males and workers. They are the original paper-makers, chewing up leaves or wood fiber into pulp out of which they build their nests, sometimes in holes dug in the ground, sometimes hanging from the branch of a tree or stuck beneath the rafters of an old house or barn. The large pear-shaped nests of the white-faced hornet are familiar to all country dwellers, and most of the evil reports we hear about wasps come from misguided persons who insist on poking down these nests with a stick. Wasps won't sting unless you hurt or frighten them; bear this in mind, if you want to study these interesting creatures.

Some of the social wasps of tropical countries build huge nests. One species in Ceylon often has homes six feet long; another in South America mixes earth with the paper pulp and with the mixture makes walls as solid as stone.

Annual Rise and Fall of the Wasp Republics

Unlike the hives of bees, the wasp communities last only one summer. All of the members die at the approach of cold weather, except a few queens, who sleep through the winter and in the spring lay the foundation for new nests and new generations. Each queen builds a few comb cells made, like the walls of the nest, of paper. In each cell she lays an egg,

HOME LIFE AMONG THE WASPS

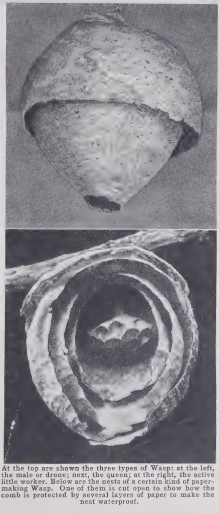


which hatches in about eight days. She then feeds the legless grubs until in about 14 days they become pupae, and 10 days later full-grown workers. These immediately take off her hands the task of enlarging the nest and providing for the new batches of young. As food becomes more abundant the queen produces queen eggs and male eggs, and when food is exceedingly plentiful the workers themselves often develop the faculty for laying eggs.

With the exception of certain tropical honey wasps, all wasps feed their young on animal food, consisting usually of other insects.

While the social wasps exhibit admirable community instincts, it is among the solitary wasps that the most amazing habits and the highest intelligence are found. There are hundreds of species, some as large as hornets, some less than a quarter of an inch long; and their colors vary from dull black and brown to brilliant reds and yellows and blues. Almost every species has some strange habit peculiar to itself, but it is in building nurseries for their young and in hunting and overcoming their prey that they show their most amazing and varied skill.

The mother, among "solitary" wasps, is confronted with the fact that her children are very greedy and will only be satisfied with the flesh of living or recently killed prey. She must, therefore, not only build a safe nest in which to lay each egg, but must stock that nest with fresh food on which the waspling may begin feeding the moment it leaves the egg. This task is more difficult than might appear, for each species of young wasp demands its own particular kind of food. One eats only a certain kind of fly; another requires a carefully chosen caterpillar; a third will have only spiders; others dine exclusively on special beetles, grasshoppers, crickets, cockroaches, ants—but the list is too long to be given entire.

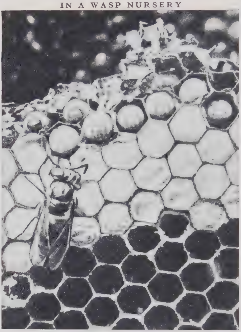


At the top are shown the three types of Wasp: at the left, the male or drone; next, the queen; at the right, the active little worker. Below are the nests of a certain kind of paper-making Wasp. One of them is cut open to show how the comb is protected by several layers of paper to make the nest waterproof.

Let us follow the caterpillar wasp (*Ammophila*) on a hunting expedition. She has built her nest in the ground, hidden perhaps under the leaf of some plant. It consists of a tunnel an inch or two long, leading down at a sharp angle to a small pocket. Before departing for the chase, she carefully closes the opening with a lump of earth and smooths it over so the keenest eye can hardly find it; then after a careful survey of the neighborhood, as if to fix the spot in her memory, she is off on her quest for provisions.

It may take a few minutes or several hours, but sooner or later she finds her game—a green caterpillar resting on a leaf. She attacks at once, and her strong jaws soon close over its back near the head. Standing high on her long legs, the wasp then lifts the front of the caterpillar from the ground, curves the end of her long abdomen underneath, and thrusts in her sting between two segments of her victim's body. At once the caterpillar becomes limp and helpless. The sting is withdrawn and plunged carefully between other segments.

IN A WASP NURSERY

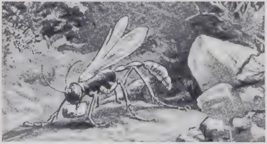


The young Wasp which has just emerged from its chrysalis is trying out its powers by walking over the paper-capped cells in which its brothers and sisters are still tucked away. The caps are put on by the grubs themselves just before they settle down for a nice long sleep in the silky cocoons they have spun for themselves. In some of the upper cells the cap has not yet been made and you can see the fat white grubs almost filling their cosy quarters.

Now she picks up her prey and, half running and half flying, makes her way back to the nest. She digs out the opening, drags the caterpillar inside, lays an egg on one of its middle segments, comes out, closes up the hole carefully, and is off hunting again.

But here is the strange thing: The caterpillar *is not dead.* With the skill of a trained surgeon, the wasp has thrust her poisoned lancet into the nerve centers which control the creature's motion, leaving it alive but paralyzed. In this cruel but necessary manner, she has made sure that the food supply for her young will not decay or dry up before the egg hatches two or three days later.

MOTHER WASP'S TAMPING TOOL



Much as men by machinery lift and let fall great weights in driving piles, or a foundryman uses his tamping tool in tamping the sand in his mold, this Digger Wasp uses pebbles to hammer down the earth over its nest.

How the wasp knows where those delicate nerve centers are situated is one of Nature's mysteries. Comparatively few people realize that the motor nerves of insects and spiders are situated on the under side, instead of along a spinal column at the back, as in the higher creatures. Yet the solitary wasp seems to be born with that knowledge. There is a species of beetle-hunting wasp of Europe, described by that great French naturalist Henri Fabre, which is compelled to press down upon the body of its victims in order to open the one joint in their armor through which the sting, with unerring accuracy, can reach its mark.

The tarantula-killer of the American Southwest by clever tactics induces her dangerous prey to rise in defense on its back pairs of legs, exposing the vulnerable spot on the big spider's breast. A quick thrust of the wasp's sting disables the monster, and it has been known to remain alive but motionless for more than five weeks after this operation.

The quantity of food stored in each nest varies greatly. A single larva of a certain fly-catching wasp (*Bembex*) has been known to eat 82 flies in eight days. The mother wasp, in this case lives in the nest herself and builds side tunnels for nurseries and storehouses, feeding and watching over her young as they grow up.

The digger wasps do not show so great a skill in home building as the carpenter wasps and the mason wasps. The former bore holes in trees or old posts, or clear out the pith from the stems of certain bushes to make room for their nursery cells. The mason wasps, which include the common "mud-daubers," usually construct their cradles of mortar and small stones on walls or sun-heated rocks. The greatest skill and nicety is used in the selection of material and the shaping of the structure.

Yet it is among the digger wasps that we find what is perhaps the only case of the use of tools by lower animals. George W. Peckham and Elizabeth G. Peckham describe this amazing habit in their fascinating book 'Wasps, Social and Solitary', which has become a world classic. They tell how they saw a wasp of the genus *Ammophila* repeatedly take up in her jaws a small pebble with which she hammered down the earth over her nest, dropping it to pile on more earth, and seizing it again to pound. Other observers have recorded similar experiences.

"So far as I know," says the great nature student, John Burroughs, "there is no other animal on this continent (America) that makes any mechanical use of an object or substance foreign to its own body in this way."

Although some wasps attack and destroy large numbers of domestic bees and a few species injure trees by gnawing them, the wasp tribe as a whole do mankind a tremendous service by destroying numbers of harmful bugs, beetles, flies, and caterpillars. Before killing a wasp, therefore, it is well to try to find out whether it is friend or foe.

A QUEEN'S LONG WINTER NAP

When this Wasp Queen decided to go to sleep for the winter, she gripped a netted curtain with her jaws, let go with all her legs, and hung there until spring.

Many of the wasps have between the thorax and abdomen the slender joint which has given rise to the popular term "wasp waisted." Most of the hornets, however, lack this feature. The mouths of the wasps are built for sucking, but less perfectly than those of bees, so that wasps can draw nectar from shallow flowers only.

The so-called "velvet ants," the largest of which is the Texan "horse ant," are really not ants at all but wingless relatives of the wasp tribe, as is shown by their sharp stings. Wasps belong to the order of insects called *Hymenoptera*, and are divided into two super-families, the *Vespoidea* and *Sphecoidea*, the former including all the social wasps and a few of the solitary varieties. The *Vespoidea* (true wasps) include the families *Vespidae* (hornets, yellow-jackets, and social wasps), *Eumenidae*, and *Masaridae* (solitary wasps). The hornets and yellow-jackets form the genus *Vespa*. The *Sphecoidea* are mud daubers.

NATURE'S CHIEF TOOL *and Its* AMAZING POWERS

How the Whole Structure of Our World is Based on the Properties of a Drop of Water—Its Part in Sustaining Life—Harnessing the Streams to Turn the Wheels of Industry

WATER. The oldest thing the human eye can look upon is water. Inside a glass of water is a history beside which the history of the human race seems but an hour or two.

In the very first days that we imagine in the story of the earth, the water that now lies in the ocean beds was held in space as gas, for rains of fire were falling then, and in that hot atmosphere water could only exist as steam. Liquid water first appeared when the atmosphere had cooled enough to enable the steam to condense upon the surface of the earth, forming the water that fills the rivers and streams and oceans of the world. It makes up at least five-sevenths of all the surface of the globe, about seven-eighths of the animal body, and nine-tenths of many sorts of plants.

Of the few substances out of which all the universe is made—so few that a man could write them all on a post-card—one of the most vital is water. Without it we could not live. It is the most ancient, the most familiar, and the most vital thing with which Life has to deal.

Inside a drop of water lie properties and powers on which the whole balance of Nature depends. When the earth cooled down and the surface was solid rock, there was water, the best solvent that could be devised, to break down rock and form a fruitful soil. When the sun poured down its heat, there was water, with its marvelous power of equalizing temperature. When life began upon the earth, there was water, moving in its everlasting cycle to keep earth sweet and clean. When man appeared, there was water, the only substance on the earth that can meet many of the countless needs of the human frame.

How Water Helps Make Weather

Of all the available substances on earth, water alone has such a high specific heat—that is, such a power of absorption of heat; and to this remarkable quality of water the world owes its daily life. It is this unique power of water that helps to maintain the equable temperature of lakes and streams and oceans, that moderates our summers and winters, that creates ocean currents, circulates the winds, and aids the distribution of vapor which brings us rain. No other liquid that could take the place of water has the high specific heat which gives water its remarkable place in life.

No other substance that could take the place of water has the unique property of water when it freezes. Most things contract when they freeze; water expands; and but for this unique property our rivers and lakes and oceans would freeze into masses of solid ice and never melt. There could be no life as we know it if freezing water acted like most other freezing things. It is water that maintains the equable temperature of the human body. If the specific heat of water were like that of almost any other liquid the temperature of the body, which must be maintained within a few degrees, would vary from 100 to 150 degrees, the complex system of chemical structures within the body would be irrevocably upset, and we should perish. As a maintainer of temperature, as a dissolver of solid material in the earth and man, water is a matchless thing, and nothing else in Nature would be so economical or efficient.

Water has in many ways during the last few years increased its hold as one of the foundation-powers of the modern world. Who does not know that the power of thousands of millions of drops of water falling over Niagara now drives mighty engines and lights up trolley-cars in the streets? Who does not know that the fact that water has a sort of skin, a stickiness, and what the scientist calls a "surface tension," has often been of great value to discoverers and inventors?

There is a new pump in which the recognition of this principle of cohesion makes it possible to pump up millions of gallons of water to great heights with nothing but a chain to hold it. This pump relies upon the marvelous power of water to hold together, as it does, for instance, when you fill a glass to the brim and then drop something into it, so as to raise the water above the brim without spilling. How firmly this surface tension of water will hold is seen every time we make a soap bubble, especially if we make such bubbles as scientists have sometimes made, bubbles that last for weeks before they burst; though sometimes, just before they burst, the thickness of the watery film is but a millionth part of an inch or less (*see* Soap Bubbles).

Without pure water no life could live upon the earth and this simple thing, the oldest visible thing we know, is coming more and more to take its place in the world's great industries as well. The horse-power potential in the rivers and streams and waterfalls throughout the world is beyond the dreams of man, and the day must come when it will be developed for the universal benefit of mankind. Then water, which makes life possible for man, may make leisure possible for him too. It has been estimated by government experts of the United States that the horse-power that could be developed from all the nation's waters is somewhere between 100,000,000 and 200,000,000, of which only about 12,000,000 are at present developed. Of 200,000,000 horse-power it is believed that 55,000,000 could be made available without special provision for storing the spring-time flood-water, and a scientist has calculated that 55,000,000 horse-power would save the United States every year the work of nearly a million miners and other workers.

In Canada the potential horse-power has been estimated at over 30,000,000. In 1910, 12 municipalities began to draw power from Niagara Falls, receiving together about 750 horse-power. Now more than 200 municipalities in Canada receive power from Niagara Falls, and the total power generated on both sides of the Falls is over a million horse-power (*see* Niagara Falls).

The ancient foundation of life is thus becoming a modern foundation of power and the bright star of hope for engineers in their efforts to make life easier and richer for all of us.

WILSON DAM AT MUSCLE SHOALS: A STUPENDOUS WORK OF ENGINEERING

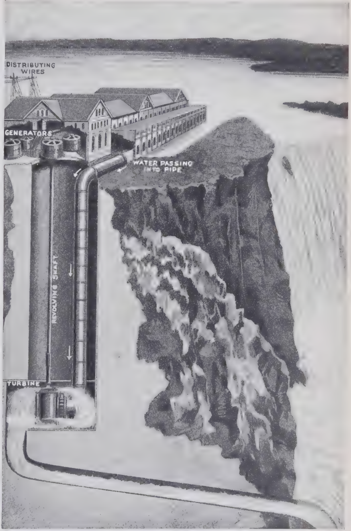
This great concrete wall, 137 feet high and four-fifths of a mile long, stretches across the Tennessee River at Muscle Shoals, near Florence and Sheffield, Ala. It is the world's hugest masonry dam, containing 36,000,000 cubic feet of concrete, and it stores up enough water to furnish 600,000 horse-power of hydroelectric energy. The spillway section, which you see above, has 58 steel gates which are opened at seasons of high water to let the flood waters pour through at the rate of nearly a million cubic feet a second. Wilson Dam was under construction for seven years and cost $46,000,000. Long before the World War the federal government had considered plans for harnessing the power of the Tennessee River at Muscle Shoals, where the river drops 140 feet in 37 miles. Actual development did not begin until 1918, when the United States faced the problem of producing its own nitrates for the manufacture of explosives. Then two great nitrate plants were built here with all possible speed, and work was begun on Wilson Dam, to supply the enormous amount of electricity needed for nitrogen fixation (*see* Nitrogen).

The advantages of water-power—"white coal," as it is often called—are so obvious that neglect to develop its full possibilities may seem like letting wealth flow away to the sea. But a water-power plant demands a larger initial investment of capital in proportion to the amount of power obtained than a steam-power plant. Furthermore, the power must either be utilized within a few hundred feet of the stream from which it is derived, or be transmitted as electricity, at further expense, to the point of utilization. Much of the world's potential water-power therefore would prove too expensive to be worth while, at least under present conditions.

Water-power is utilized by means of wheels. Until the recent invention of the turbine, all waterwheels were merely variations of the paddle wheel. If the stream is carried by a flume and allowed to strike buckets or paddles on top, the wheel is called "overshot." If the stream passes beneath the wheel, it is "undershot." A third type is the "breast wheel," in which the water strikes the wheel at a level with the axis or slightly above. Where the supply of water is small but the "head" or pressure is great, "impulse" wheels are used. In these one or more streams of water are directed through nozzles against cup-shaped buckets. These types of wheels cannot be made to deliver power satisfactorily in the enormous quantities needed by modern power plants. For this reason they are giving way to the water turbine, usually in connection with an electric generator (*see* Turbine).

Water is a compound of two volumes of hydrogen with one of oxygen (H_2O). It is a very stable compound, readily passing from solid to liquid and gas (at atmospheric pressure, to ice at 32° F. and below; to steam at 212° F. and above) and back again without loosening the bonds which hold the oxygen and hydrogen together. Water ceases to be water only under most extraordinary circumstances.

HARNESSING THE POWER OF NIAGARA



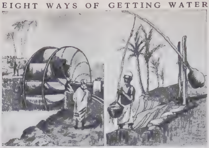
Falling water, as Nature provides it, is the cheapest and most dependable source of power. Ancient waterwheels and mills show that men have known for ages that this power could be utilized. Here you can see exactly how modern engineers have harnessed Niagara Falls, so that the energy which would otherwise be wasted is used to create electrical power. The water is first diverted into a pipe or series of pipes, through which it falls with tremendous force to operate a turbine engine at the bottom. This turbine engine then turns a driving shaft, which sets the electrical generators to work. From the generators distributing wires carry electric current to cities and towns many miles distant.

Liquid water is almost incompressible, hence its employment in certain types of hydraulic machinery (*see* Hydraulic Machinery). It shrinks slightly on cooling until it reaches the temperature of 39.2° F. (*see* Heat); then it expands, the ice which forms being about $\frac{1}{11}$ greater in volume than the water. That is why water pipes burst when they freeze.

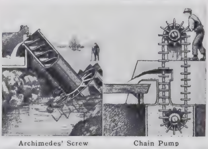
When the plumber thaws the pipes, he uses, for every ounce of ice melted (though not heated above ice temperature), heat enough to raise an ounce of water from freezing temperature to over 79° C. (175° F). In scientific terms, the *latent heat,* or amount absorbed in changing one gram from ice to water, is 79.68 calories. The reason the temperature does not rise when this great amount of heat is absorbed is that all the heat is used to convert the ice into liquid.

When you boil water, for every ounce changed into steam no hotter than boiling water you heat enough to raise 536.7 ounces of water one degree C. (1.8° F.). The latent heat of steam is therefore 536.7 calories. Liquid water itself can pack away more heat in proportion to its weight—that is, it takes more heat to raise a given weight of water one degree—than any other substance except hydrogen. In other words, the specific heat of water is higher than of any other substance except hydrogen. This means that the water in your hot water bottle can supply you with more heat than the same quantity of any other substance at the same temperature.

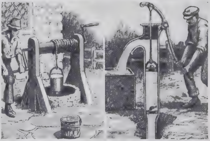
EIGHT WAYS OF GETTING WATER



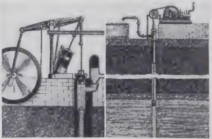
Persian Wheel Egyptian Shadoof



Archimedes' Screw Chain Pump



Windlass Well Lift Pump



Pumping Engine Deep Well Pump

The Persian wheel was revolved by ox-power, pouring water from its flukes through holes in the hub. The shadoof is an even simpler device. The screw invented by Archimedes was operated by the force of the current. The chain pump consists of a series of pistons working through a pipe. The well with its windlass and the hand-pump are largely replaced today by power pumps operated by windmills or motors.

Under standard conditions a cubic foot of pure water weighs 62.32 pounds. Before you had gone far under water, then, the weight of the water above you would be crushing. The sidewise thrust against the shores and the resistance of the water itself takes up a part of the weight, so that the pressure upon every square inch of an immersed object increases somewhat less than $4\frac{1}{2}$ pounds for every ten feet of depth (*see* Diving). At one mile the pressure increase would be more than a ton to the square inch.

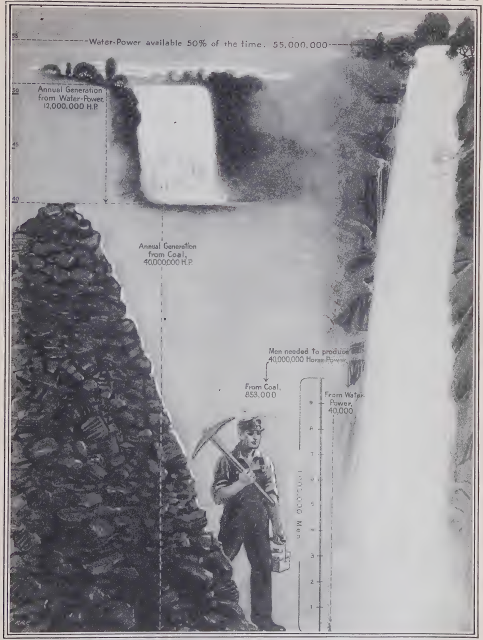
Water is rarely found pure in nature. Even rain water contains foreign matter taken into solution while passing through the atmosphere. Water which contains enough calcium or magnesium salts to prevent free lathering with soap is called "hard." Water in which soap works freely is "soft." (*See* Waterworks.)

WATER-BUGS. This is a common name given to several kinds of insects which live in streams or ponds. They belong to a large group known as the *Hemiptera,* or true bugs, which have beaks for piercing their prey and sucking blood. If you hold one tightly it may give you a painful jab.

The water boatman is one of the familiar varieties. This is an oval-shaped gray-and-black mottled bug, with one pair of its legs very long and fringed with hairs. These two long legs project out from the boat-shaped body like a pair of oars and row the insect through the water.

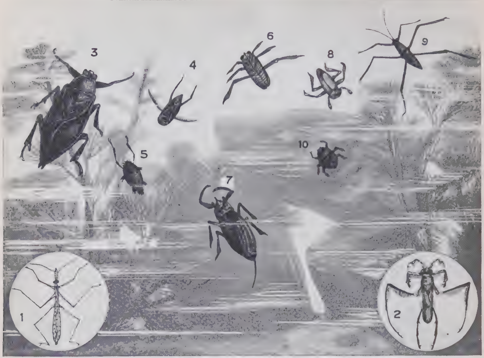
The back-swimmer is shaped something like the water boatman, with sharper hind end. This curious creature always rows himself through the water upside down, with his stomach uppermost. That is why he is called back-swimmer. He hangs from the surface by the top of his abdomen, where there are hairs arranged in bunches. One beautiful and very common species of back-swimmer has a handsome glistening white back and two brilliant red eyes.

ELECTRIC POWER IN THE UNITED STATES


55
Water-Power available 50% of the time. 55,000,000
50
Annual Generation from Water-Power, 12,000,000 H.P.
45
40
Annual Generation from Coal, 40,000,000 H.P.
25
20
Men needed to produce 40,000,000 Horse-Power
From Coal, 853,000
From Water-Power, 40,000
9
8
7
6
5
4
3
2
1
1,000,000 Men
KRE

If the great streams and waterfalls of the United States were harnessed to generate electricity, they would produce about 55,000,000 horse-power a year (if flood waters were stored it might reach 200 millions). This vast power is far greater than the total now produced by the use of coal, as you can see from this drawing. Yet, of this tremendous supply of energy, only 12,000,000 horse-power has been put to work — the remainder awaits development. There is also another side to the question. It takes about 853,000 men — miners, coal-heavers, firemen, engineers, etc. — to produce the 40,000,000 horse-power from the coal. The same power could be produced in hydro-electric plants with the labor of only 40,000 men.

EXPERT SWIMMERS OF THE INSECT WORLD



You have only to watch the still waters of any pond to see all sorts of gymnastic performances by the many bugs which live in such quiet waters. All of the water-bugs shown here are common in most parts of the United States. Two of them (1 and 2) are enlarged, as they would appear under a magnifying glass; all of the others are slightly smaller than natural size. 1. Marsh-Treader. 2. Riley's Water-Strider. 3. Giant Water-Bug. 4. Water Boatman or Water Cicada. 5. Black Whirligig. 6. Back-Swimmer, under view. 7. Water Scorpion. 8. Another kind of Water Boatman. 9. Water-Strider. 10. Creeping Water-Bug.

The water-scorpion is a long brown creature, with long spindling legs and awkward movements. It lives on the bottom of ponds amid pieces of stems, etc., which it resembles. For this reason it is sometimes called the water-stick. It is a very fierce creature and catches and sucks the blood of all sorts of insects, some larger than itself.

The giant water-bug, or electric-light bug, is the largest, as well as the one most to be feared by small fish and other inhabitants of ponds and streams. It is about two inches in length, and is oval in shape, brownish, and with a long beak and big eyes. Like the June-bug, these creatures can often be found on summer nights crawling underneath electric lights on street corners or dashing into the light to their death.

The creeping water-bugs are little roundish creatures that may be found crawling over the bottom of ponds looking for other insects upon which to feed. Often they come out and crawl along the grassy shores.

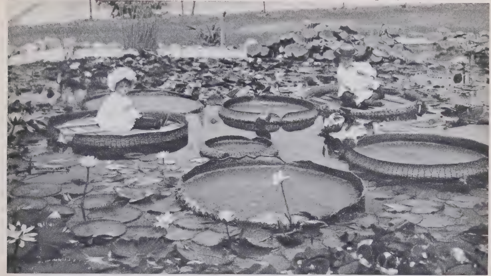
The water-skater, or water-spider as it is sometimes called, has a long narrow body and six spidery legs by which it darts over the surface of the water with hardly a ripple. The middle pair act like rapidly moving oars, while the hind pair are used to steer. The short legs in front rest lightly on the water, ready to shoot out and seize any unsuspecting insect that comes within reach.

Water-bugs of all sorts are easily caught and make interesting pets in an aquarium. The big electric-light bug should never be put in with small fish or frogs, for it will attach itself to them and kill them by sucking their blood.

The scientific names of two common species of water boatman are *Notonecta undulata* and *Notonecta glauca;* common form of water scorpion, *Nepa cinerea;* of water-skater, *Hydrotrechus remigis.* The electric-light bugs are known as *Belostomidae.* In addition to the species described in this article, there are a number of water beetles to which the name "water-bug" is sometimes applied (*see* Beetles).

WATER-LILY. A pretty Indian legend holds that the water-lily was once a star which fell from its place in the azure sky and striking upon the water was changed into a flower. This "queen of the water" finds its home in the waters along the border of lakes, in quiet shallow places where the soil is rich. The thick stems make their way to the surface, adjusting themselves to the water's depth and serving as anchors

WATER-LILIES WHICH SERVE AS RAFTS



This giant among Water-Lilies, the *Victoria regia*, has flat leaves 6 to 7 feet in diameter, with rims 4 to 6 inches high; the upper surface of the leaves is a bright green, the under side a vivid crimson. The flowers, which vary from 8 to 16 inches across, shade in color from a delicate rose or pink to pure white. The plant is a native of the Amazon valley, where it grows in sluggish or stagnant waters, often covering the surface solidly for miles. Specimens are successfully grown in botanical gardens.

for the flowers which majestically float in their field of flat waxy-green leaves. The blossoms usually open and close at dawn and sunset, and their life is about three days; but some expand in the evening only, others close soon after noon, and still other varieties remain open throughout the day. The seed-pod ripens beneath the water, dropping its seeds on the loamy bottom. The exquisite flowers may be found from June until September ranging from Nova Scotia to the Gulf of Mexico, and westward to the Mississippi.

To the water-lily belongs the gigantic *Victoria regia* of the Amazon, with enormous white flowers, and leaves so broad and firm that they are capable of bearing the weight of a man. There are various other species of this family distributed throughout the world, ranging in color through white, pink, and yellow to blue. Our present-day water-gardens contain water-lilies assembled from all parts of the world; and many hybrids have been bred combining loveliness of form and color with hardiness.

Scientific name of the fragrant American white water-lily, *Castalia odorata*. The yellow pond-lily or "spatterdock" belongs to the genus *Nymphaea;* its seeds formed part of the food of some Indians, and are still eaten under the name of "water chinquapin." The lotus is an Old World member of the water-lily family.

WATERLOO, BATTLE OF. The history of Europe might have been very different if it had not rained in Flanders on the night of June 17, 1815. At daybreak on the 18th, Napoleon, mounted on his white horse, was scanning the battlefield of Waterloo, but it was nearly noon before the mud was dry enough for the artillery to advance. Meanwhile the Prussians, who had been defeated two days before at Ligny, were slowly but none the less surely making their way through the muddy roads to the aid of the British.

Only three months before, Napoleon had slipped away from his island prison of Elba, off the coast of Italy. When he returned to France his old soldiers had flocked to his standard. He had hurried north with his army, hoping to defeat his quarreling enemies before they had a chance to unite. His plan seemed successful. He got between the English, who were concentrated in the vicinity of Brussels, and the Prussians, who were east of the road from Brussels to Charleroi. On the 16th Ney held the English engaged at Quatre Bras, while Napoleon crushed—as he thought—Blücher's Prussians at Ligny. After the battles he left Grouchy with orders to follow Blücher, and turned his attention to the English. Blücher, however, drew off to the north and marched to the assistance of the British, while Grouchy wasted precious time searching for him to the east of Ligny.

The British meanwhile retreated to the little Belgian village of Waterloo, nine miles southeast of Brussels. Napoleon overtook them late on the 17th, but could not attack until the following morning. After delaying until 11 o'clock he gave orders to advance. For ten hours the battle raged, Napoleon repeatedly hurling his columns of cavalry against the stubborn squares of the bayonet-wielding British infantry. For a time it seemed as though the ranks must give way before the terrible onslaught, and the

Duke of Wellington, the British general, anxiously awaited the promised Prussian aid. Finally, late in the afternoon, Blücher's men arrived. Those hours that Napoleon had waited that morning saved the day for his enemies. The French made their last desperate attack, but were slowly overborne. By nine in the evening their defeat was a complete rout. Seven times their flying forces were halted for the night, but each time they were driven onward. So desperate was the fighting that the combined losses were more than 50,000.

Napoleon's defeat was decisive. In Paris four days later he signed his second abdication. (*See* Napoleon I.)

WATER-PLANTS. The enormous group of plants that live in or on the water is remarkable for the various ways in which its members have adapted themselves to such a life. Those that live wholly under water, supported thereby in quiet depths, have no wood or "bast" to stiffen them, but those in running water are tougher. Another common adaptation is the development of conspicuous air-passages, such as you see in the stalks of water lilies, caladiums, etc. It is necessary for air to be brought into the plant and carried to parts which are too much shut off from air by water.

The roots in most cases are much reduced, and in some cases they have disappeared entirely. Where they exist, they serve chiefly as anchors, not for extracting food from the mud. The air cavities would hoist the plant from its position were it not securely fastened. Many water-plants, however, do float bodily throughout their existence. Common duckweeds in myriads form sheets of green scum on stagnant ditches. They are extremely tiny, but the similar water-hyacinth is large; its huge rosettes drift together in wide rafts under spikes of azure flowers buoyed up by their hollow swollen petioles, and in southern bayous they seriously obstruct the passage of even large boats. Gulf-weeds and other kinds of seaweed are kept afloat by numbers of little globular air-bladders.

The leaves too show interesting adaptations. Submerged leaves have no "stomata" or breathing pores. Frequently the leaves are very finely divided, especially in running water, thus presenting less resistance to the water and objects borne along in it. The many slender long leaves also present a larger surface to the water whence they draw their nourishment. Some have no submerged leaves at all. The leaves that float, such as the "pads" of water-lilies, are usually thin and flat, round or oval in shape, supplied with air-filled cavities for buoyancy, and with flexible slender stems, long enough to allow for changes in water level. They have breathing stomata on the upper surface. They are often purplish beneath, this color being due to a chemical within the cells which has the power of changing light rays into heat—an advantage in a cool stream.

The reproduction of some under-water plants differs from that of land-plants. Some bear spores, or both flowers and fruits, beneath the surface, where the pollen floats away to other plants; but most of them have devices for blooming at or above the surface, the flowers either floating on the water, or, more usually, poised on stems reaching above it. The tape-grass sends its staminate (pollen-producing) flowers adrift to collide with the stationary pistillate ones, and thus transfers the pollen from the one sex to the other. But with water-plants as with land-plants, insects and breezes are the usual pollen carriers.

Various water-plants have seeds or fruits provided with buoyant envelopes, so that when they ripen and fall on the water they can sail before the wind or ride on the current. The seeds of water-lilies are imbedded in fleshy pods which, when decayed, form a slimy mass from which waterfowl pick out the fruits to eat, thus carrying seeds on their smeared bills to other districts. Seeds and even tiny plants are also carried at times, stuck on the muddy feet or the plumage of waterfowl.

As a result of the variety of modes of dispersal, and of the ease of dispersal by the water itself, together with the uniformity of conditions of life in the water, certain water-plants are thought to have a wider distribution than any other kind of plant.

There are three conspicuous types of water-plants, or hydrophytes, to use the scientific name. The first type is made up of the "free floating societies," that is, those in which the plants are entirely sustained by water and are free to move either by locomotion or water currents. To this group belong the ordinary pond societies, composed of algae, duckweeds, etc., which float in stagnant or slow-moving water. The second type is made up of the "pondweed societies," in which the plants are anchored, but their bodies are submerged or floating. Here belong the associations of seaweeds, among which there are often elaborate systems of holdfasts. Another conspicuous pondweed society is that which contains among its representatives the water-lilies with their broad floating leaves and the pondweeds or pickerel weeds with entirely submerged leaves. The third type is made up of "swamp societies," in which the plants are rooted in water or in soil rich in water, but the leaf-bearing stems rise above the surface. The conspicuous swamp societies are "reed swamps," characterized by tall rushes, cat-tails, and reed grasses, wandlike monocotyledons which usually form a fringe about shallow margins of small lakes and ponds; "swamp moors," the ordinary swamps, bogs, marshes, etc., which are covered by coarse grass; "swamp thickets," in which there is a tangle of willows, alders, etc., "sphagnum moors," in which the sphagnum moss prevails and is accompanied by numerous orchids, heaths, etc.; "swamp forests," in which the tamarack (larch), spruce, pine, hemlock, and juniper are the prevailing trees.

WATERSPOUT. Travelers and seamen sometimes tell strange tales of twisting columns of water called waterspouts which seem to rise from the surface of the sea and reach up into the clouds. For a time it was believed that such spectacles were the result of a kind of suction that forced the sea water upward, but now we know that waterspouts are caused by tornadoes which form over lakes, streams, or the ocean itself (*see* Storms). The spout is merely the funnel-shaped cloud of all tornadoes. The water in the spout is fresh and not salt, a fact which proves that the column is formed by the condensation of the water vapor in the air. It is true that the water of the lake or ocean just beneath the spout is much disturbed and rises somewhat inside the column. That is due to the fact that the inside is almost a vacuum. The rising of the water is due to the same causes which blow out the walls of houses in a tornado. Waterspouts are most common in warm waters where thunderstorms are apt to occur. They are most numerous in the tropics of the Pacific ocean. They usually last for only a few minutes.

HOW *Modern* CITIES GET *Their* WATER

Aeration Fountain of the Catskill Aqueduct System of New York City

WATERWORKS. If by some magic we could see in a glass of water the moving picture of its journey to our home, we should see portrayed a story of much interest. In New York the story would start high up in the Catskill Mountains, where the pure waters of the mountain springs are gathered in great reservoirs one more than 90 and another more than 125 miles distant from the city. Great tunnels so large that a railroad train might enter are built from these to the city's water system. The water from the reservoirs is constantly slipping into these tunnels, to plunge downward through the darkness and mystery of the subterranean river, gathering a force from gravitation that will carry it through the water mains of the city up to the 20th story of the towering buildings. Imagine a good-sized river turned about so that its mouth is placed at the lake in the mountain. All the branches which were once feeders for the big river are now fed by the water rushing down from the lake, and the little branches are going out among the homes and great industries of the city.

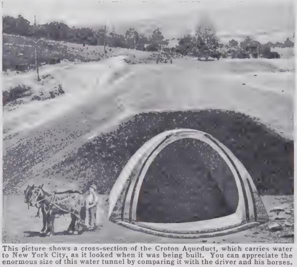
In Chicago a number of tunnels, large enough for a man to walk upright in, run two and sometimes four miles out under the bottom of Lake Michigan, to bring in water which is purer than that nearer shore. First, the water flows into basins at the pumping stations, and then the great steel pumps, working ceaselessly day and night with the power of 10,000 horses, force it out through the distributing mains to all the parts of the city.

If you live on a farm or in a village, the story of your water supply has to do chiefly with the work of nature. We might begin each of these stories with the evaporation of the water from all the earth, when the vapor rises into the clouds to be returned to the earth as rainfall. Perhaps the rain is caught from the roofs of buildings where smoke and dirt are not excessive, and stored in cisterns for use in bath and laundry. In some instances this water is filtered and used for drinking. Or the rain falling upon the earth may continue its journey down through the ground which is nature's filter, to be stored in layers of porous rock or confined in rocky chambers. Wells are dug into which this water may seep. In such cases it is important to dig the wells where the soil is free from contamination with the agents of disease. Wells may also be bored or driven to tap the water which is deeper underground. The water from these wells may be drawn by the "old oaken bucket," the hand pump, or the pump operated by a windmill or gasoline engine. A constant and ever ready supply of water where and when needed may be obtained in the country as well as in the city, for water may be pumped and stored in an elevated tank. From this tank, pipes can be installed leading to taps in the kitchen sink, the laundry, the milk house, the barn, or wherever else it is needed, and the stored water can then be used whenever it is wanted.

The American Indians and other tribal peoples made their camps beside the natural water supplies, and if for some reason these waters dried up and failed them, they would roll up their tents and move. Civilized man refused to move so easily. The Chinese have an ancient proverb which says, "Dig a well before you are thirsty." China has a great many wells. Some of them are 1,000 and 1,500 feet deep, and are probably the deepest wells that are used successfully.

But even numerous small wells could not supply the needs of the homes and industries of a great city, even those which existed in very ancient times. In Egypt, Assyria, and Babylonia, water was conducted from the river-beds through open canals to the cities, to help supply city dwellers. But the mighty Romans far outstripped all other peoples of ancient days in the energy and engineering skill devoted to the construction of their water systems. Rome brought water clear and fresh from the distant hills, and first nine and later fourteen streams flowed through costly and marvelous aqueducts of brick and stone to supply the city's fountains, public baths, and public buildings. The aqueducts of Rome were large enough to supply 375 gallons a day for each person, although the amount actually delivered may have been less because of leakage from the long conduits and the storage reservoirs. Similar aqueducts were constructed for Roman cities throughout the vast empire (*see* Aqueducts).

A SECTION OF THE CROTON AQUEDUCT



This picture shows a cross-section of the Croton Aqueduct, which carries water to New York City, as it looked when it was being built. You can appreciate the enormous size of this water tunnel by comparing it with the driver and his horses.

The cities of the Middle Ages were much less enterprising than ancient Rome, and the terrible ravages of pestilence in that age were undoubtedly due to the restricted use of water and to the pollution of the city wells. Paris in 1550 had a drinkable water supply equal to one quart a day a person, and at the end of the 17th century the supply if evenly distributed would have amounted to only 5 pints a person. Our modern cities do much better than that. In the year 1854 the records show that Chicago pumped over 9 gallons a person, and now, 286 gallons a person, showing what progress has been made in that length of time. This last figure is larger than that shown for any other city in the United States, and European cities allow much smaller supplies.

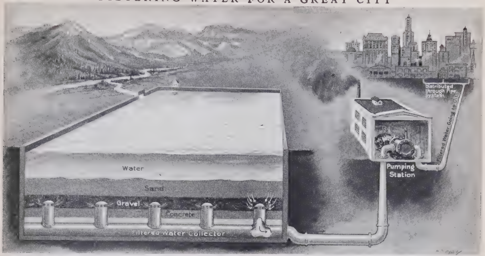
We have learned to do one important thing which the Romans did not do, and that is to pipe this water into each house. The Romans served very few individuals and then only at a great expense, for a special lead pipe was run from the reservoir out to each house served. If the pipes distributing water in New York City today were laid in one continuous main they would reach from that city across the continent to Spokane.

For the early distribution systems, hollow or bored tree trunks were used. The end of one tree pipe was tapered to fit into the hollowed-out end of the next tree pipe to make the joint. At one time the company which supplied water for London had 400 miles of wooden-pipe water mains. A great deal of water was wasted by leakage in such mains and the wooden pipes had to be renewed frequently. The pipes were small and as many as 10 separate lines were laid in some streets to furnish enough water to the customers on that street.

In the early systems, too, water was only pumped during a part of the day. If the baby of the household awoke in the middle of the night and cried for a drink of water, there would be trouble unless water had been put by for just such an emergency. Water was not distributed under pressure, either, so the water could be obtained only from faucets at or near the level of the ground. This was not only inconvenient but it afforded little fire protection. There was the further danger that impure surface water would seep into the leaky mains where the water flowed along without pressure and while the mains were not in continuous use.

The use of iron pipes became general at the beginning of the 19th century. With these pipes for the distribution systems, and the use of the steam engine to run the pumps, the development of the modern wat

FILTERING WATER FOR A GREAT CITY



You think of a water filter as a small affair that might be installed in any kitchen. Consider, then, this filter which covers acres. The water flowing down from the hills is gathered in the reservoir, whose bottom is composed of fine clean sand overlying a gravel bed. The water seeps through, depositing its impurities in the sand, and is then collected through screened pipe-heads thrust up into the gravel. From there it is pumped clean and clear into the city mains. A filtering station usually has several of these reservoirs, so that the water from any one of them can be drained and the sand changed without interfering with the regular supply.

systems began. In the modern distribution system, water is supplied under pressure. This increases the amount of leakage from the pipe joints, but prevents the seepage of the surface water into the pipes. This pressure is maintained so that an exceptional demand, such as occurs in case of fire, finds the system instantly ready for the emergency. Such a practice of course makes it necessary to build the entire system on a scale suited for fire-protection, although for the greater portion of the year this great capacity is not needed. Some large cities are now avoiding a portion of this expense by building high pressure fire protection systems in the business and manufacturing districts, and providing domestic water supply from less expensive low-pressure systems. Modern cities are also abandoning the old "unlimited supply" system in favor of metered service, in order to distribute the expense among the water users in proportion to the amounts they use (*see* Meters).

The Science of Water Supply

Because of the enormous consumption of water in modern cities, and the necessity of finding this supply within a limited area, municipal water supply has grown to be a highly technical science. The basis of any water supply problem is the need—how much water must be delivered daily—and the probable future demand as the city grows. If a city does much manufacturing, engineers usually figure upon a total great enough to supply 100 gallons daily for every member of the current population, but are careful that the total capacity of the plant designed upon this basis can be increased as the population grows.

The next problem is to find this amount of water without drawing upon supplies needed for other cities. The first consideration is purity, and when possible engineers try to have a "drainage area" established in a mountain or forest region, and draw their water from it, sometimes with and sometimes without the use of purification processes. Such an area is then patrolled constantly by guards in order to prevent contamination. New York City's area in the Catskills is the leading example of this practice.

Usually, however, a sufficient supply can only be obtained by drawing upon water which in its natural state is admittedly impure, and in such cases some means of purification must be adopted. The chief methods are filtration, sedimentation, and chemical treatment. The "slow sand filter" consists of a layer of sand from two to four feet deep, resting on a thick bed of gravel, with drains beneath the gravel. From three to six feet of water is admitted over the sand, sinks through it, and is carried away by the drains. During the passage through the sand most of the impurities are removed. Such a system will purify from two to five million gallons of water daily for every acre of filtering surface. The top layer of sand must be removed from time to time, because it becomes clogged with the impurities it has retained.

The sedimentation process uses shallow basins or reservoirs without filter bottoms. The water is allowed to stand for a number of days in a basin before being used (intermittent system) or is made to flow gently from one to the next (continuous system). In either case, the impurities gradually sink to the bottom.

Chemical treatment consists either of coagulation or direct bactericidal purification. In the former process chemicals which produce a gelatinous mass are introduced into the water, and as this mass sinks, it strains out the impurities. Such a system is valuable when water is highly charged with mud. When the water is clear and only bacteria are feared, some bactericidal agent, as chlorine gas, is introduced, and the water is used without further delay. In a few cases where the only available water is particularly bad—as in the case of a large prairie city whose only possible water supply is from a dirty river—several of these processes may be used in combination.

After quantity and purity are assured, steadiness of supply must be provided for. Both drainage areas and rivers furnish most water in the spring, and least in the summer, when water is needed in the greatest quantities. In order to preserve the spring-time excess for use in the dry season, great dams impound the water in artificial lakes designed to hold enough water to supply the city during the times when the natural daily supply is deficient.

We have learned from experience that water service because of its importance must be a *public* service available to everyone. Where private companies furnish water today, these companies are generally regulated by state or municipal commissions. Often the municipality has undertaken to furnish the service as a department of the local government, and in a number of states these municipal utilities are regulated by the state commission the same as private companies. (*See* Public Utilities.)

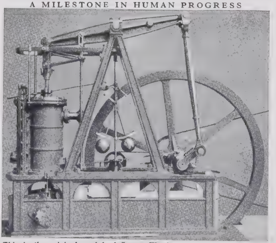
If you live in a city perhaps you can find out what kind of a water system you have. A visit to the pumping station will show you the great pumps which throb ceaselessly day and night, sending the water through the main arteries, out through the smaller branches, to the very fingertips of the city.

WATT
Who Perfected the Steam Engine

WATT, JAMES (1736–1819). Everbody has heard the story of James Watt and his boyhood experiment on the lifting power of the steam under the lid of his mother's tea-kettle. It is a beautiful picture, that of the home life of James Watt, in the fishing-town and customs-port of Greenock, Scotland. He was a delicate sensitive lad, whose life was preserved only by the most tender care. His father was a man of means and importance, and his mother was known to the fisherfolk as "the beautiful leddy."

Unable to attend school regularly because of ill health, James Watt followed his own inclinations in study and amusements. Long days were spent in rambling among the hills and lakes back of the town, developing strength and turning his thoughts toward botany, geology, and water-power. He was no less interested in his father's shipbuilding yards and in the docks. He loved to sit in the window of the parlor fronting the harbor and watch the herring boats come in and the big sailing vessels, laden with tobacco from Virginia, riding at anchor in the broad estuary of the Clyde. Who could imagine that this fragile dreaming boy was to transform his native town from a straggling village of thatched cottages into a big bustling seaport with great shipbuilding yards where the Cunard and other famous lines of steamers are constructed and sent out to sea?

A MILESTONE IN HUMAN PROGRESS



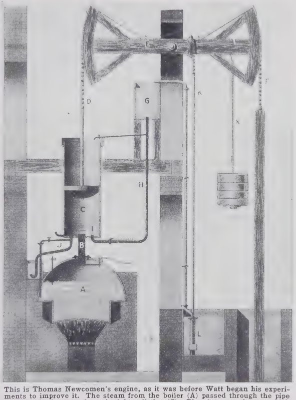
This is the original model of James Watt's perfected steam engine, as it appeared about 1800, the year in which Watt retired from active work. Before Watt's time, the steam engine was useful only as a pump, but Watt adapted it to drive machinery of all kinds.

In his father's shops the boy became so skilful in the use of tools that the workmen said of him: "Wee Jamie hae a fortune in his fingers, an' anither in his heid." It was intended that the gifted boy should go to Glasgow University and be fitted for a professorship in physics, but the loss of a vessel at sea and other family financial misfortunes forced him to abandon this ambition. So the lad went to London at 19, to learn the trade of scientific instrument-making. It took 12 days' hard riding to make the journey of 400 miles.

When he had learned his trade he was appointed mathematical instrument-maker to the Glasgow University, with a shop in the college precincts. One day a small model of a steam-pump from the University laboratories was put into his hands for repair. This led him to make a thorough investigation of the whole subject of steam, including condensation and latent heat, to see why this sort of pump, then used in British coal mines, used so much steam and gave so little power. He set about the task of improving and developing this crude and wasteful type of engine. It took a year of close study. But let the inventor tell the story.

"One Sunday morning," he wrote, "when I had gone for a walk in the Green of Glasgow, the idea occurred to me that, as steam is an elastic vapor, it would expand and rush into a vacuum. The separate condenser would take care of the exhaust, and the steam-jacket keep the cylinder hot. I rushed back to the university and broke in upon Dr. Robison, lecturer on chemistry, and cried: 'You needna fash yoursel' aboot that ony more, mon; you shall have steam boiling hot, in a boiling hot cylinder, and not waste a single particle."

THE AWKWARD PUMP WHICH WATT TRANSFORMED



This is Thomas Newcomen's engine, as it was before Watt began his experiments to improve it. The steam from the boiler (A) passed through the pipe (B) into the bottom of an air-tight cylinder (C). The piston or plunger which fitted snugly in the cylinder was fastened by a piston rod (D) to a rocking beam (E), to the opposite end of which hung a counterweight (X). The steam was under very little pressure, but it was enough to relieve the vacuum beneath the piston in the cylinder, and as soon as steam rose the counterweight drew the piston to the top. Immediately this happened, water from the tank (G) ran down the pipe (H) into the bottom of the cylinder at (I). This cold water caused the steam to condense, again creating a vacuum below the piston, which was forced down once more by the air pressure above it. This process drew the pump rod (F) up and down, which worked a pump deep down in the mine. The rod (K) operated the small pump (L) which supplied the tank (G). The various valves were usually operated by hand.

The modern steam-engine had been born in James Watt's brain—a flash of genius, it has been called. Such it was, but it was the result of profound knowledge, intense application, and patience.

Watt's first changes made the steam-engine quick-acting, powerful, and saving of fuel, but it was still useful for pumping only. It was 16 years (1781) before it was developed to the point where it could turn a wheel and be used in spinning factories and in running other sorts of machinery. Watt's business partner, and the man who by his financial aid made the success of his inventions possible, was Matthew Boulton of Birmingham, a talented and far-sighted capitalist.

At 64 James Watt, having, as he said, "a sufficient fortune," retired to the country. He there spent nearly 20 years as an experimenter and physicist—in his many interests and activities resembling Benjamin Franklin. "What is life without a hobby to ride?" he is quoted as saying. He always had some scientific hobby to engage his inquiring mind. Now it was the composition of water, or an illuminating gas, or the fertilizing of his broad farm lands; at another time, a uniform system of weights and measures, anticipating the metric system of today; and one of the chief units of electrical power, the "watt" is named in his honor. With the eagerness of a boy he experimented in his laboratory, "wearing out my life, not rusting," until he died on Aug. 19, 1819. (*See* Steam Engine.)

WAVES. When you throw a pebble into the pond, the particles of water displaced by the stone rise in a ring—they must; there is no other place for them to go. Then gravitation pulls them down, displacing some of the water outside of the ring, which is thus in turn compelled to rise, only to be pulled down by gravitation; and so the circle of waves or ripples goes on widening.

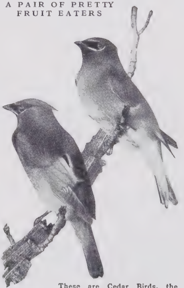
The production of water waves by wind is similar. Wherever the wind makes an exceptionally heavy downward thrust at the surface, it displaces the water, which is piled up in a wave. As the wind keeps pushing against the waves thus formed, they tend to increase in height and length, particularly out at sea, where there is nothing to retard or break them. In the southern Indian Ocean waves 675 feet long (length is measured from crest to crest) and from 38 to 45 feet high have been measured. Near the Cape of Good Hope waves have been observed to run so high that two vessels of ordinary size were completely hidden from each other when lying in the troughs of adjacent waves.

Does the water move forward with the wave? That is a question which you may answer for yourself. Watch a floating bottle on waves off shore, and you will see it bob up and down in nearly the same position. Shake one end of a rope extended on the ground; waves run along it from one end to the other, but no part of the rope moves forward. So it is with the particles of water in a wave: they merely rise and fall in the same spot, except in the kind of wave known as a "wave of translation," which actually carries the water particles onward in its course, as in breakers, for example.

Wave motion occurs in other substances as well as in water. The waves which are of most vital importance to us are those produced in air and the ether of space (*see* Ether). Such are the waves of ether which give us light, heat, X-rays, and certain forms of electricity; and the waves of air which chiefly give us sound. (*See* Heat; Light; Sound; Wireless Telegraph and Telephone; X-Rays.) The speed of waves in an elastic and homogeneous medium is dependent on the elasticity and inertia of the medium alone; therefore all the ether waves, from the largest Hertzian wave, measured in miles, to the smallest X-ray wave, travel at the same rate, about 186,000 miles a second. Sound waves travel through air at various velocities, depending on temperature and other conditions affecting its elasticity and density. For practical purposes we say they travel about 1,100 feet a second.

WAX. Wax is harder than fat, and does not melt so easily. It will not dissolve in water, and burns with a bright flame. Beeswax, Chinese insect wax, and spermaceti (obtained from the sperm whale) are animal waxes, while Japanese wax, palm wax, and myrtleberry wax are vegetable waxes. Beeswax forms the cells in which bees store honey. It is prepared by draining out the honey, melting the comb in boiling water, and collecting the wax from the top of the water as it cools. Myrtleberry wax is made from the berries of the wax myrtle or bayberry, and is largely used for fragrant Christmas candles. Paraffin, produced from petroleum, is also much used as wax for candles, and for other purposes. In many of its properties it seems similar to the waxes described above, but chemically it is very different. (*See* Fats and Oils; Gums.)

A PAIR OF PRETTY FRUIT EATERS



These are Cedar Birds, the handsomest members of the Waxwing family.

WAXWING. A waxwing's wonderful beauty once saved the lives of hundreds of its mates. Vermont fruit-growers introduced into the assembly a bill which would allow them to shoot cedar waxwings. It passed the house, in spite of the arguments of bird lovers. When it came to the senate, instead of arguing, the opposers brought into the chamber a mounted specimen of the bird, and the bill was defeated.

The waxwing's plumage is a perfect blending of gray tones, with the fore parts flushed with pink. His high pointed crest rises from a setting of velvety black feathers. His tail is beautifully tipped with yellow, and the wings, which show white and yellow, have the secondary feathers ornamented with red sealing-wax-like tips, from which comes the name.

The family of waxwings (*Bombycillidae*) includes three species only—the cedar waxwing (or cedar-bird) of North America, the Bohemian waxwing of the Arctic, and the Japanese waxwing of Asia. They are akin to the silken flycatchers of Mexico and Central America.

These forest dwellers build large nests in forks of trees. They have from three to five young. When the birds are able to care for themselves the families join in flocks of 50 or 60 birds; flying in close order, they roam over the country, stopping where insects and fruit are abundant. Waxwings are not song birds, but their note is soft and pleasant. Scientific name of cedar waxwing, *Bombycilla cedrorum.*

WAYNE, ANTHONY (1745–1796). "Mad Anthony" Wayne was one of the most striking figures of the American Revolution. With the exception of Washington and Greene, he was the best general on the American side, and without exception he displayed the most reckless bravery shown by any soldier on either side.

Like Washington he was a surveyor in early life, and was sent by Benjamin Franklin to Nova Scotia as agent for a proposed colony there. When the Revolutionary War began, Wayne raised a regiment of volunteers with which he served in the disastrous campaign against Quebec. For a time he was in command of Fort Ticonderoga, and by his skill in engineering won the rank of brigadier-general.

It was on the battlefield, however, that he was of most service to the cause of the colonists. At the battle of Germantown it was his troops who, with the bayonet, drove back the Hessians, and only retreated under orders when the attack had failed elsewhere. At Monmouth he and his Continentals first checked the British advance. At Stony Point on the Hudson, he led the most spectacular attack in the whole war, and by a fierce but short fight won a complete victory and the strongest British post on the Hudson River. This daring enterprise aroused the enthusiasm of the country and won Wayne a gold medal and the thanks of Congress, besides the nickname by which he was ever afterward known.

As the last years of the war were filled chiefly with fighting in the South, Wayne was sent to that section in 1781, and when Cornwallis surrendered he was coöperating with Lafayette at Yorktown.

The skill which Wayne had acquired in the Revolution was to be of further use to his country. In 1792 he was commissioned major-general and commander of the armies against the Indians, whom he defeated in the battle of Fallen Timbers in August 1794. It was due to this victory and the Treaty of Greenville which Wayne made with the Indians that a great stretch of territory in the present states of Michigan and Indiana was opened to settlement. This service, which is often overlooked, was fully as valuable to his country as any of the more spectacular feats which Wayne performed during the Revolutionary War, but it was destined to be his last, for he died at Presque Isle in Lake Erie in 1796.

WEASEL. The weasel is a small carnivorous mammal related to the marten, mink, and skunk. It has a remarkably slender round body with a long neck, which gives the animal the appearance of having the fore legs set back too far. The legs are very short. The weasel can twist and wind its supple body in a fashion very like a snake and enter holes where only a snake could follow.

The common weasel, found both in the Old and New World, reaches a length of eight or ten inches. It is light reddish brown and whitish below, and in northern districts becomes whitish in winter. It feeds on mice, moles, and rats, following them into their holes, and attacks even rabbits, grouse, chickens, and ducks. It also visits birds' nests, killing the birds and eating the eggs. It is a bloodthirsty and wasteful little animal, killing far more animals than it can consume. It ranges in America east of the Rocky Mountains, and south to the states of Tennessee and North Carolina.

The ermine fur of commerce is usually the winter coat of a North American or Siberian member of the weasel family. The least weasel of Canada and Alaska, sometimes called the "mouse weasel," is the smallest known carnivorous animal in the world. (*See* Ermine; Marten; Mink; Skunk.)

Scientific name of common weasel, *Putorius vulgaris;* of least weasel, *Putorius rixosus.*

The WEATHER PROPHET *and His* WISDOM

The Men Who Keep Track of Sun and Rain, Wind and Temperature, and Tell You What to Expect Tomorrow—How the Countless Bits of Information are Gathered and Their Great Value to Agriculture and Commerce

WEATHER BUREAU. Will picnic day be fair, or will pouring rain spoil the fun? The Weather Bureau of the United States government can tell you 36 to 48 hours in advance, and, except for local flurries, be right nine out of ten forecasts.

Uncle Sam is right in these forecasts because he does not guess. Every morning and every evening the telegraph wires hum with reports of weather conditions from about 200 stations throughout the country. These reports are sent to two main receiving stations, Chicago and New York, and from there are redistributed to the proper local stations. Reports are also received from ships at sea and from foreign places.

From this mass of information the district forecasters at Washington, Chicago, New Orleans, Denver, and San Francisco make up forecasts for their various states. Local forecasts based on these district forecasts are made at most of the other first-order stations.

These forecasts, with warnings of frosts, cold waves, storms, and heavy snows, are distributed throughout the country by telephone, telegraph, radio, and mail. All newspapers print the reports, flag signals announce their principal features to ships in harbor, and radio stations flash them to ships at sea. Special reports are sent to aviation centers about air conditions—direction and velocity of winds, cloud heights, and visibility.

This elaborate organization costs the United States nearly $3,000,000 a year, but it saves many times that amount of property. Railroads regulate their shipments of perishable and refrigerated freight according to the reports; ships at sea are warned in advance of storms, and many of them avoid hurricanes by being warned in advance to stay in port until the storm has passed. The reports enable grain exchanges to foretell the effect of weather upon crops, and farmers and fruitgrowers often avoid loss through untimely frosts by heeding the Weather Bureau's warnings.

The services of the Weather Bureau were also of great help during the World War. Trained weather men were enlisted to help the armies, not only by supplying information to the flying squadrons, but also to increase the accuracy of fire of the artillery, and to aid in selecting the time for gas attacks and infantry advances.

To guide the forecasters in making their predictions, the weather conditions at all stations are charted upon a map, both morning and evening. A small circle marks each reporting station, and the circle is shaded or tinted to show the character of its weather, as "clear," "snow," or "rain." An arrow beneath the circle shows the direction of the wind.

Barometric readings, showing the atmospheric pressure at the different stations, are also recorded and the regions of lowest pressure are marked "low," while those of highest pressure are marked "high." Lines connecting the points of equal pressure are then drawn about these "lows" or "highs" as centers. Such lines are called "isobars." Points of equal temperature are connected by broken lines which are called "isotherms."

With this data charted, the coming weather is almost as obvious to the trained forecaster as though it were printed upon the map. Experience has shown that these highs and lows pass across the country in predictable paths, and each center carries its own weather with it. Thus, if today's map shows a warm rainy "low" over Denver, while wind velocity and direction and other conditions indicate that by tomorrow this center will be over Omaha, the probabilities are that there will be a warm rain over Omaha, on the following day.

Reading the Minds of the Winds

There are many other considerations, of course, which will affect the details of this prediction. In predicting "cold waves," for instance, the forecaster has several theories to consider. One is that the wind from the northwest has been thoroughly chilled by blowing over the cold plains of Canada and the more northerly states. Another is that the cold wave is simply the down rush of air from cold regions far above the earth. It is known, however, from the records that the cold wave comes only when there is a "high" to the west of a "low"—that is, where there is a downward whirl in the atmosphere west of an area of low pressure. If that explanation is true, the zero air has not been blown south from Canada, but has sunk earthward from great heights. When one remembers how very still the atmosphere often is during a cold snap in winter, the second explanation seems the more reasonable.

The most difficult prediction problem confronting the Bureau is that of rain. Its methods enable it to forecast heavy storms, cold waves, and hot weather with almost unfailing accuracy; but its rain predictions are still somewhat uncertain.

There are some 6,000 observation stations in the United States, some of which make complete daily reports, while others record only certain weather conditions of importance in their locality. The more important stations are equipped with very delicate instruments. The record of the temperature is kept by accurate thermometers, and the atmospheric pressure is measured by barometers. Instruments called hygrometers measure the moisture content of the air. Gauges of snow- and rain-fall are usually open cylinders into which the moisture falls and is measured. The familiar weather vane gives the direction of the wind, and other instruments called "anemometers" measure the pressure and velocity of the wind. Most of these instruments can be made self-registering, that is, the changes in the instrument are recorded on a chart moved along by clock-work so as to give a continuous record of a certain number of hours. There is, for example, a sun recorder, which is equipped with a pen that marks on the chart only when the sun shines on it. Many other instruments are used, so delicately adjusted that the records seem almost magical.

The Language of the Weather Flags

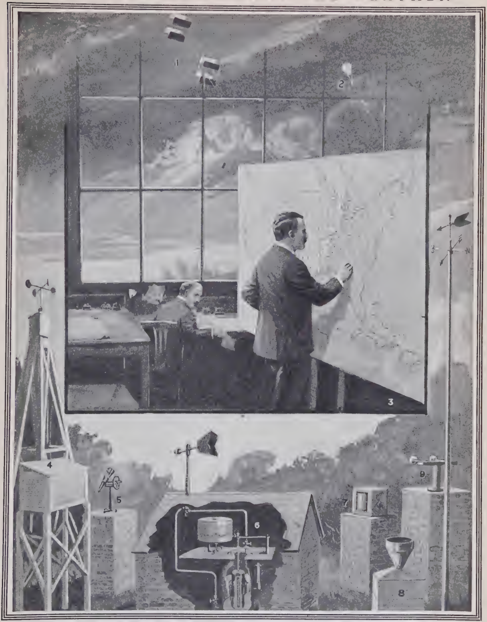
In signaling forecasts the Weather Bureau uses a white flag for fair weather; a blue flag for rain or snow; a white and blue flag for local rain or snow; and a white flag with a black square in the center for a cold wave. A black triangular "temperature" flag is placed above one of the others to indicate warmer, and below to indicate colder weather. For storm signals red flags are employed, and the direction from which the storm may be expected is indicated by triangular pennants.

Permanent weather records are kept in the United States and other countries, and these become very valuable when made continuously for long periods of time. The records now available disprove the rather common belief that the weather of the United States has undergone a change and that there is no longer the severe winter weather of the "good old days." Perhaps the snow stayed on the roads for a longer sleighing season because there was less travel to wear it down, and the trains were stalled for weeks at a time because there were no snow plows to clear the track. (*See* Climate.)

The United States was the first country to make weather forecasting an important part of the work of its government. In 1879 a weather bureau was established as a branch of the signal service in the War Department, and some 20 years later it was transferred to the Department of Agriculture. The United States Weather Bureau today is furnishing the most complete service of its kind in the world.

The whole subject of weather and climate falls under the science known as *meteorology*, and in addition to its daily predictions the Weather Bureau is doing all it can to develop this science. One of its important activities in this connection is to obtain complete and accurate records of conditions in the upper air by sending up instruments attached to kites and balloons. The Bureau hopes that this work will throw considerable light upon the causes of weather, and enable it to make predictions even more accurately and farther in advance than at present.

HOW WE LEARN ABOUT THE WEATHER



1. Kites are used to lift meteorographs for recording conditions in the upper atmosphere. 2. A small balloon with a parachute and a meteorological instrument in a box is set adrift. When the balloon reaches a very high altitude it bursts, and the parachute brings the instrument safely to earth again. In this way records are obtained of conditions in the upper atmosphere, at altitudes too high for man to reach. 3. A weather forecaster placing storm signals on the weather map, in an American meteorological station. 4. An anemometer, which is merely an instrument for measuring the velocity of the wind. 5. Theodolite, for determining the altitude of clouds. 6. Anemograph, for measuring and recording wind pressure. 7. Self-recording instruments for measuring temperatures. 8. Rain gauge, a simple arrangement for measuring rainfall. 9. Sun thermometer, a device for registering the actual heat of the sun's rays, as distinguished from the temperature of the air.

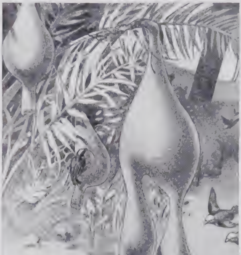
WEAVER-BIRD. Of all curious bird homes, those made by the weaver-birds are the most wonderful and unique. Though varying in size and shape, the same elaborate interweaving of grass or leaf-strips is found in nests of all the 200 or 300 species of this family.

The weavers are small finch-like seed-eating birds, belonging mainly to Africa. Some species, however, are found in Asia and some in Australia. The plumage is generally plain, but during the mating season the male birds show bright colors. Though continually chirping and chattering, these birds do not sing. Their nests, unlike those of the oriole, are not hanging pockets, entered from above, but are of various shapes and sizes, generally entered from the lower end or the side.

The baya of India often hang their nests from the bough of a tree over water. Starting with a solidly wrought rope, the nest opens out into a globular chamber, and then contracts into a tube several inches in length, through which the birds enter.

The most wonderful nests are those of the social weavers of Africa. These are community nests usually attached to a tree in the form of a huge mushroom top. The structure, woven of grass, is several years in the building. The parent birds repair and use the same nests year after year, and the young birds add their nests to the parent structure. Thus the size of the circular roof grows until from a distance it is often mistaken for the thatched roof of a native hut. As many as 320 individual nests have been counted under one of these community roofs.

THE HANGING NESTS OF THE WEAVER-BIRD



The Baya Weaver-Bird of India usually builds her nest from the branches of a tree which overhangs a stream. The nest is weighted with lumps of clay to prevent it from swaying at the mercy of every breeze. The natives say that the birds catch fireflies and fasten them into the nest for the purpose of frightening away rodents, snakes, and other enemies.

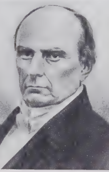
WEBSTER, DANIEL (1782–1852). On Jan. 26 and 27, 1830, was delivered probably the greatest and most important speech that was ever heard in the United States Senate. It was made in reply to an address by Senator Hayne of South Carolina, who had declared that the Federal government was but a loose confederation of sovereign states and that the states could refuse to obey laws of Congress. "Black Dan" Webster, senator from Massachusetts, was the speaker, and his speech gave him undisputed first place among all the great orators in the golden age of American oratory.

Webster arose to speak to packed galleries. In appearance he was grave and dignified. He had the noblest head America has produced—smooth-shaven, heavy-featured, with swarthy skin, brilliant eyes, and beetling brows; and his rich voice had the range and melody of a chime of bells. The simplest man could follow his plain diction, while his logic and weight of argument delighted and convinced the most learned. He showed clearly that the doctrine of "nullification" could lead, logically, only to disruption and civil war. The speech was a defense of the Federal Constitution and an appeal to national patriotism. It lifted the whole question of states' rights from the plane of a political theory to that of national ethics. One who heard it said: "That is the greatest oration since the Greek orator Demosthenes delivered his celebrated oration, 'On the Crown'." Its closing paragraph is forever memorable:

> When my eyes shall be turned to behold for the last time the sun in heaven, may I not see him shining on the broken and dishonored fragments of a once glorious Union; on states dissevered, discordant, belligerent; on a land rent with civil feuds, or drenched it may be in fraternal blood! Let their last feeble and lingering glance rather behold the gorgeous ensign of the republic, now known and honored throughout the earth, still full high advanced, its arms and trophies streaming in their original lustre, not a stripe erased or polluted, not a single star obscured, bearing for its motto no such miserable interrogatory as "What is all this worth?" nor those words of delusion and folly, "Liberty first and Union afterwards"; but everywhere, spread all over in characters of living light, blazing on all its ample folds, as they float over sea and over the land, and in every wind under the whole heavens, that other sentiment, dear to every true American heart—Liberty and Union, now and forever, one and inseparable!

The Frail Beginnings of a Rugged Frame

The man who made this great speech was born on Jan. 18, 1782, at Salisbury, N.H. How often, in reading the lives of great men, do we find them so frail in childhood that it was not thought probable they would live to maturity! Daniel was so delicate that he was the only member of a pioneer family who was exempt from hard labor. His mother, a woman of uncommon intellect and force, early discovered the boy's remarkable mental powers, taught him all she knew, and insisted upon his entering the local academy. When he was 15 it was decided at a family conference that he must go to college, no matter at what cost of toil and self-denial for the others. The sensitive boy burst into tears at this proof of devotion and confidence in his ability. When he graduated from Dartmouth, he taught in an academy until he could send his brother Ezekiel also to college. After being admitted to the Boston bar, in 1805, he settled in the small town of Boscawen, N.H., in order to be near his father, who died a year later. Returning to Boston, he established a good practice, only to turn it over to his brother and to begin again in Portsmouth. American history records no finer example of family affection and loyalty than is furnished by the Websters. "Black Dan's" loyalty was wide as well as deep. In a Fourth of July oration, delivered at the age of 18, he made an impassioned appeal for love of country, in a time when the people as a whole had scarcely outgrown their strong sense of separate colonial origins.


WEBSTER
America's Most Brilliant Orator

His Eloquence Brings Him Fame

So shy as a child that he could not stand up in school to speak pieces, Webster won such a reputation for eloquence at the bar that, at the age of 30, he was a member of Congress from New Hampshire. After remaining there four years, he retired to return to the Boston bar. His income soon rose to $20,000, a great sum in those days. His reputation became national with his winning of the famous Dartmouth College charter case. This decision was of importance because it asserted the authority of the Federal government over the states, and was a blow at the theory of states' rights. In this early period he delivered a trio of historical orations—one in 1820 on the second centennial of the landing on Plymouth Rock, one on the laying of the corner stone of the Bunker Hill Monument, and one on the deaths of ex-Presidents Adams and Jefferson in 1826. These addresses served still further to place his broad patriotism before the American public. Such a man could not escape the duty of public service. In 1823 he was again in Congress, this time from Massachusetts. In 1828 he was chosen to represent Massachusetts in the Senate. There he remained until his death in 1852, except while serving as secretary of state under Harrison and Tyler, and again under President Fillmore. While in this office he negotiated the treaty with Great Britain which settled the Maine boundary dispute.

On many political questions of the day Webster seemed then to vacillate. In perspective he is seen to have been consistent to one principle. A free-trader, he became a protectionist on the ground that, since protection had been established, it must be maintained or businesses built up under it would be demoralized. Although opposed to the extension of slavery, he joined Clay in securing the passage of the Missouri Compromise. On the other hand he supported Jackson in the Force Bill, which authorized the President to use the army and navy to enforce Federal laws in any resisting state. The truth is that he hated nullifier and abolitionist alike, and fought every measure and every opinion which tended to divide North and South. He was concerned only with preserving the Union. As early as the great speech of 1830 he predicted civil war as the inevitable result of these sectional interests, but he helped to delay the conflict until the Federal government was strong enough to meet the shock. In the meantime he sowed seeds of national patriotism broadcast by his impassioned eloquence and unanswerable logic of history. His compromising attitude on slavery probably lost him the presidency, for abolitionist sentiment was growing in the North, and the abolitionists could not forgive his support of the Compromise of 1850. But the principles laid down in his speeches were followed consistently by President Abraham Lincoln.

WEBSTER, NOAH (1758–1843). Few men have had as great an influence in fixing the pronunciation and spelling of our language as the author of the first dictionary of the English language produced in America.

Noah Webster was born in Hartford, Conn., and educated at Yale College. His studies were interrupted by the Revolutionary War, in which he served as a volunteer, but he was graduated in 1778. While teaching in Goshen, N.Y., in 1782–83, he became aware of the need of better textbooks, and shortly afterward published his famous 'Spelling Book', which was widely used for nearly a century. In the next 20 years he practiced law in Hartford, edited a paper in New York, served as judge and member of the Connecticut House of Representatives, and wrote political pamphlets and a number of books.

In 1807 he began his 'American Dictionary of the English Language'. To fit himself for the work he spent ten years in the study of the English language and its connection with other languages. Seven more years were spent in preparation of the dictionary, including a visit to Europe to consult books and scholars at Paris and Cambridge. The fact that Webster included 12,000 words and between 30,000 and 40,000 definitions that had not appeared in any earlier dictionary indicates how thoroughly he did his task.

The work was finished in 1825 and published in 1828 in two volumes. Since that time it has been a standard dictionary of the English language.

In compiling his dictionary Webster had in mind the special needs of his own countrymen. He followed the best American usage of his time, sometimes departing slightly from the English forms, and choosing the simpler of two spellings whenever he felt warranted in doing so. He is responsible for fixing the spelling *wagon*, instead of *waggon; develop*, rather than *develope; theater, miter, center*, rather than *theatre, mitre, centre; color, labor, honor*, instead of *colour, labour, honour;* etc.

While working on the dictionary, Webster lived part of the time in Amherst, Mass., and was one of the founders of Amherst College. He also served in the Massachusetts legislature. He returned to New Haven in 1822, and died there in 1843.

WEEDS. Lurking about every garden and every plowed field, hiding along roadsides, lying in wait behind hedges, a great army of wild weeds is always waiting the moment when the farmer or the gardener sits down to his well-earned rest.

Then, like the barbarian hordes that overran Europe centuries ago, they pour forth to the attack, sweeping over fields and flower beds, choking down, crowding out, destroying all the civilized plants that stand in their way.

They are well trained fighters, these weeds, hardened to their task by generations of starving in sandy and rocky soil, by long struggles against hot winds and driving colds. The fair fat vegetables and grains, the delicate flowers, accustomed to man's care and protection, can offer but feeble resistance.

And when the farmer or gardener rushes into the fray with poison liquids to squirt on his enemies, with hoes and rakes to grub up their roots, with every device of modern agricultural warfare, the wily weeds adopt tricky tactics. Some put down roots beyond the hoe's reach, where they wait patiently for a chance to spring up again, each little rootlet sending out a strong new weed. Others hasten early in the season to scatter their seeds broadcast so they will be plowed under, ready to sprout at the favorable moment. Some mature quickly and have large families of children before the nodding grain has ripened to seed. But the most dangerous of all are those that become spies, imitating the appearance of their domestic rivals. These are harvested with the grain or hay, and mingle their countless seeds with the true crop. In this way the weed seed is sowed with the good seed and revels in idle luxury, safe from attack. In a single pound of clover seed, for instance, no less than 14,000 seeds of 44 different weed species have been found.

The Spoiled Children of Mother Nature

A weed has been described as "a plant out of place," but that means out of place only so far as man is concerned. Mother Nature seems to favor these spoiled children in her family. They are the irrepressible bad boys of the vegetable kingdom, strong, vigorous, and healthy, always first to seize an opening, able to fight their own battles and elbow their way where they are not wanted, and survive under nearly all circumstances.

If they are a great nuisance to the farmer and gardener, they are often, on the other hand, intensely interesting to the plant lover. In almost every case weeds have developed some special apparatus or weapon which enables them to outwit or overcome their foes. The nettle has its stinging hairs, which drive off grazing stock; the dandelion has its white-winged barbed seeds, which travel far and fasten firmly; the hawkweed has its ground runners that creep out and take root on all sides of the parent plant; the burdock has its bristling seed pods with fish-hook points that cling to your clothing or sheep's wool and are carried far and wide; the tumble-weed goes rolling with the wind for miles scattering its seed as it goes; the black nightshade has its poison; the ladies' sorrel and jewel weed have a seed-shooting apparatus which snaps out the seeds like little pop-guns to quite a distance; the picturesque milkweed—so called from the milky juice which issues from the stem when broken—has rough-coated pods, and when these burst, clouds of lovely silky tufts bearing little flat brown seeds are wafted by the breeze far and wide over the countryside; and so on down the countless list.

There are a great number of beautiful flowering plants which, because they come up in the wrong places, are often called weeds by the farmer. Black-eyed Susans and the lovely New England asters are often considered weeds when they grow too abundantly in meadows.

Some weeds are annuals, dying in the winter and relying on their seeds to "carry on" the next spring. Some are biennials, storing up in their fleshy roots or leaves the food they have gathered in order to have an early start the second year, producing their seeds before the other plants can. Others are perennials, living through the coldest winters and springing up afresh year after year, unless pulled roots and all out of the ground. Purslane and ragweed are good examples of annuals; burdock and wild carrot, or Queen Anne's lace, are common biennials; while field sorrel and the Canada thistle are familiar perennials.

Those Troublesome Burrs

Among the weeds which carry burrs are the cockleburs, beggarlice, devil's pitchforks, and greenburs. Chief among the grasslike weeds are Johnson grass, crab grass, and switch grass. Other common weeds are the bindweed, or wild morning-glory, the smartweeds, the pigweeds, tumble weeds, chickweeds, peppergrass, wild mustard, partridge pea, lupine, plantains, cacti, thistles, pokeweed, sneezeweed, fleabean, goldenrod, madder, and toad-flax.

The loco weed of the Western and Southern states is one of the most sinister of weeds. The name, the Spanish word for "crazy," is given to several species of plants belonging to the vetch family (akin to peas and beans), which affect the horses, cattle, and sheep that eat them, in much the same way that the use of certain drugs affects human beings. The first effects of the weed are stimulating. Continued eating of it, however, leads to dizziness and nervous and muscular derangements. Locoed horses are apt to shy violently, or rear and fall backward. Death from exhaustion or starvation is the final outcome.

Here are some of the rules for the battle against the weed army: (1) If you see weeds coming up, do not allow them to ripen their seeds, but get rid of them while they are young. (2) Do not turn under the ground weeds which bear seeds. This only plants the seeds for next spring. (3) Be careful not to spread fresh stable manure on the soil. It often contains weed seeds. (4) Watch carefully every unfamiliar plant that comes up in your garden. It may be a dangerous weed.

WEEK. The division of the month into four weeks of seven days arose partly from the moon's phases (new moon, first quarter, full moon, last quarter), which are about seven days apart. The number seven was also regarded as sacred by the ancient Babyloians, among whom this division of time first arose. Even the Chinese and ancient Peruvians used the seven-day week. The biblical story in Genesis gives six days for the work of creation, with the seventh day as a day of rest—the Jewish Sabbath (Saturday). The Christian church adopted the first day of the week (Sunday), on which Christ arose from the dead, as its sacred day of rest.

The French Revolution attempted to introduce the "decade" of ten days in place of the week, but even in France the decade was used only for a few years.

WEEVILS. There are about 20,000 species of small beetles belonging to the weevil family, and nearly every one of them is a pest to man. The worst offender among these "snout beetles," as they are sometimes called, is the famous cotton-boll weevil—an insect only one-fifth of an inch long, which each year causes many millions of dollars' loss in the cotton-growing regions of the United States. The damage is done by the grubs (larvae) of the beetle, which hatch from eggs deposited in the buds and "bolls" (pods) of the cotton plant by the mother beetle. If they hatch in the buds, the grubs devour the interior and prevent the formation of bolls; if the buds escape, later generations of grubs may attack the bolls and destroy the valuable cotton fiber.

The boll weevil is not a native of the United States; its original home is believed to have been Central America. In 1892 it crossed from Mexico into Texas, and advanced at the rate of about 20,000 square miles a year until it has spread over most of the cotton states. The annual loss caused by this one insect is estimated at more than $250,000,000.

Other members of the weevil family enormously increase this record of destruction. Each has some special plant picked out for its food. There are the acorn weevil, the hickory-nut weevil, the chestnut weevil, the plum weevil, the cherry weevil, etc., all of which are responsible for "wormy" nuts and fruits. The grain weevil attacks principally stored wheat. In addition we have the rice weevil, the corn weevil, the grape weevil, the sugar-cane weevil, the palm weevil (which infests coco-palms), the strawberry weevil, the potato weevil, the clover weevil, the pea and bean weevils, each of which makes it almost impossible to grow these crops in certain regions.

On account of their small size and the fact that the larvae are usually hidden inside the plant or fruit beyond the reach of poison sprays, weevils are hard to control. The best way is to burn all infected plants, fruit, or grain, and to plow up or dig up all the ground in which these insects spend the winter. To combat the cotton-boll weevil, the United States Department of Agriculture recommends the removal of the plants from the field at the end of the season, early planting, the use of early maturing varieties, etc.

Weevils belong to the scientific group *Rhynchophora*, and most of them to the family *Curculionidae*.

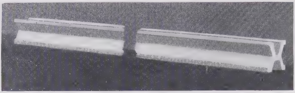
HOW LONG? HOW MUCH? WHAT *Does It* WEIGH?

Curious Old Ways of Answering These Questions, and How Modern Official Standards Have Put an End to Confusions of Measurement—The Various Weights and Measures and How They are Used

WEIGHTS AND MEASURES. So natural does it seem to us to have exact standards of weights and other measures that it takes a strong effort of the imagination to picture conditions when men weighed gold, silver, and precious stones against dried grains of wheat "taken from the middle of the ear," and when they measured short lengths by grains of barley ("barleycorns") or the first joint of the index finger, and longer distances by the length of the human foot, by the distance from the elbow to the tip of the middle finger ("cubit"), by the pacing stride, or the day's journey. With the growth of commerce and progress in civilization such rough and ready measures were replaced by more accurate and uniform standards. In the days of the Roman Empire standard weights and measures were preserved in a Roman temple and served as standards for the whole civilized world. After the fall of the Empire these standards were lost, and there ceased to be any uniformity of weights and measures. In the Middle Ages almost every town had its own standards of weights and measures, and there were even variations between those of one trade or gild and another. As late as the 18th century in Italy alone there were more than 200 units of length called the "foot." Conditions in England were about as bad until John Bird made standard yardsticks in 1758.

A good idea of the inconvenience caused by the lack of absolute and invariable standards is furnished by a German treatise on surveying of the 16th century, which instructs the surveyor to establish the length of a "rood" thus: "Stand at the door of a church on a Sunday and bid 16 men to stop, tall ones and small ones, as they happen to pass out when the service is finished; then make them put their left feet one behind the other, and the length thus obtained shall be a right and lawful rood to measure and survey the land with, and the 16th part of it shall be a right and lawful foot."

THE STANDARD METER



Preserved in the Treasury Department at Washington, D. C., is a metal bar, made of an alloy of platinum with 10 per cent iridium. It is "Standard International Meter No. 27," one of those made by the International Bureau of Weights and Measures. This bar is the standard for the United States, the ratio of the yard to the meter being legally defined as 3600 to 3937.

The names of many of our units indicate the rude measurements from which they originated. "Mile" is from the Latin *mille passum*, meaning "1,000 paces," each pace being about 5 feet—a double step. The "furlong" meant originally a "furrow long"—the length of a furrow in the usual acre strip of the medieval manorial system. The "rod," "perch," or "pole" represents the length of the ox-goad used by the plowman to measure his first furrow. The "yard" (literally, a stick or rod) is supposed to represent the length of a man's arm. The "foot" tells its own origin. "Inch" is from the Latin *uncia*, "twelfth part." "Acre" is from a word meaning "field."

THE STANDARD KILOGRAM

This is "Kilogram No. 20," which is kept in Washington, D. C. It is one of the standard international kilograms adopted by the International Bureau of Weights and Measures. The ratio of the pound to the kilogram is fixed by Act of Congress as 1 to 2.2046.

The system of commercial weights and measures used in the United States is based on that which grew up in England through age-long custom as modified by successive royal and parliamentary enactments. The standard bushel kept in the town hall of Winchester and known as the "Winchester bushel" (2,150.42 cubic inches) is the bushel measure which prevails throughout most of the United States and Canada; but Great Britain in 1826 established an "imperial bushel" of 2,218.192 cubic inches in its place. The English yard was established by Henry I as the distance from the point of his nose to the end of his thumb. The inch was declared in 1224 to be the length of three dry barleycorns laid end to end. The use of the "barleycorn" as a unit of measure still survives in shoe measurements, which are numbered by thirds of an inch or "barleycorns" in a system of 13's. The pound, roughly equivalent to the old Roman *libra* (which gives us the abbreviation "lb."), was long defined as the weight of 7,680 grains of wheat; hence the "grain" is still the smallest unit of weight in our common systems. In the reign of Henry VIII the avoirdupois pound of 7,000 grains came into use. The "troy" pound (derived from Troyes, France, an important trading center in the Middle Ages) of 5,760 grains became the unit for weighing bullion and jewels, as it still is. The "pennyweight," equal to 24 grains in the troy system, was originally the weight of the English penny.

Congress has the constitutional right in the United States to fix the standards of weights and measures, but it has rarely exercised this right, preferring to leave such legislation to the states. Hence there is considerable variation in some common standards. The "ton," for example, is usually the commercial short ton of 2,000 pounds, but in some states the statutory ton of certain commodities is defined as a definite number of cubic feet or as a certain number of bushels of fixed weight. The long ton of 2,240 pounds—the historical ton in England—is prescribed in some states for certain commodities. Hence the "hundredweight"—(the one-twentieth part of a ton) is sometimes 100 pounds, sometimes 112. The short ton of 2,000 pounds is largely used in fixing transportation rates. There is also great variation in the definitions of the gallon, the bushel, and the barrel.

For its own use, however, the Federal government has had to fix certain standards, which generally prevail throughout the country. Since 1893 the yard and pound and their parts have been defined, by order of the Treasury Department, in terms of a standard meter and kilogram, kept at the office of Standard Weights and Measures in Washington. These are exact copies of the international meter and kilogram preserved at the International Bureau of Weights and Measures in Paris.

Because of the irregularities and inconvenience of the present systems of weights and measures and the advantages of having an international system, there has long been a powerful movement in favor of adopting the metric system, which is now used for scientific work in all countries, and for all purposes in most of the countries of Europe. (*See* Metric System.)

The following tables show the chief units of weight and measure used in the United States and other English-speaking countries:

Long Measure

12 inches (in.) = 1 foot (ft.)
3 feet = 1 yard (yd.)
$5\frac{1}{2}$ yards or $16\frac{1}{2}$ feet = 1 rod
40 rods or 660 feet = 1 furlong
8 furlongs or 1,760 yards or 5,280 feet = 1 mile
3 miles = 1 league

There is a tendency to drop one or more units of this oddly built system of measurements in practical work. Thus merchants measure cloth by the yard, and express smaller quantities either in inches or in fractions of the yard, ignoring the foot. Builders use the foot and the inch, ignoring the yard. Surveyors and engineers quite commonly ignore the inch, using decimal fractions of the foot instead.

Then we have certain units used only for certain classes of measurements. Among these are the "hand" (originally a real hand's-breadth), 4 inches, used in measuring the height of a horse; the "fathom" (originally the distance measured by the out-spread arms), 6 feet, used in measuring depth of water at sea; and the "knot," equivalent to a nautical or geographical mile (= 1.15 English statute miles), used only in measuring speed of ships. The mile of different countries varies between wide limits. The American and English mile is 1,760 yards; but the Swedes know a mile as 11,700 yards, the Russians as 1,165 yards, the Italians as 1,614, the Scotch as 1,984, the Irish as 2,240, and the Germans as 5,285 or 8,805 yards, according to whether it be understood as a "short mile" or a "long mile."

Square or Land Measure

144 square inches (sq. in.) = 1 square foot (sq. ft.)
9 square feet = 1 square yard (sq. yd.)
$30\frac{1}{4}$ square yards = 1 square rod
160 square rods = 1 acre
640 acres = 1 square mile (sq. mi.)

Most of the units of area or surface measurement are the squares of the linear units. The square inch and the square foot are the most commonly used small units. The "square"—100 square feet—is a unit used in carpentry and building, for flooring, shingling, etc. In United States and Canadian government land surveys the "section," equal to the square mile, is the chief unit of measurement.

Cubic or Solid Measure

1,728 cubic inches (cu. in.) = 1 cubic foot (cu. ft.)
27 cubic feet = 1 cubic yard (cu. yd.)
128 cubic feet = 1 cord

The cubic foot is largely used to express volumes of gas, water, etc., and the cubic yard is much used in engineering; it is reckoned as about equal to one wagon-load of earth. A cord foot (of wood) is 1 by 4 by 4 feet; a cord is 8 cord feet. A "rick" or "strand" is 8 by 4 by $1\frac{1}{3}$ feet. Timber is measured by various local units; so is masonry, the masonry "perch" varying from $16\frac{1}{2}$ to 25 cubic feet.

Liquid Measure

4 gills (gi.) = 1 pint (pt.)
2 pints = 1 quart (qt.)
4 quarts = 1 gallon (gal.)
$31\frac{1}{2}$ gallons = 1 barrel (bbl.)
2 barrels = 1 hogshead

A liquid gallon in most states occupies 231 cubic inches. A gallon of water weighs about $8\frac{1}{2}$ pounds. A cubic foot of water weighs about $62\frac{1}{2}$ pounds. The British imperial gallon measures 277.27 cubic inches. The ale or milk gallon contains 282 cubic inches. Liquid measure and dry measure bear no direct relation to each other.

Dry Measure

2 pints (pt.) = 1 quart
8 quarts = 1 peck (pk.)
4 pecks = 1 bushel (bu.)

A bushel (Winchester standard) contains 2,150.42 cubic inches or about $1\frac{1}{4}$ cubic feet; but different states have established different cubic contents or weights for the bushel of various specified commodities, and also for the barrel. In general usage a bushel of potatoes is 60 pounds. The weight of a barrel of flour is commonly fixed at 196 pounds. Commodities formerly sold by dry measure, such as vegetables and fruit, and even eggs, are increasingly sold by avoirdupois weight.

Avoirdupois Weight

$437\frac{1}{2}$ grains = 1 ounce (oz.)
16 ounces = 1 pound (lb.)
2,000 pounds = 1 ton (T.)

In many places the long ton (2,240 pounds) and the long hundredweight (112 pounds) are legal standards. The "stone" (14 pounds) is a unit of weight much used in England.

Troy Weight

24 grains = 1 pennyweight (dwt.)
20 pennyweights = 1 ounce
12 ounces = 1 pound

The troy pound was legalized in 1828 as the standard unit to be used by the United States Mint. The apothecaries' pound and ounce are the same as the troy pound and ounce.

WEIMAR (*vī'mär*), GERMANY. In the quiet little city of Weimar, full of memories of Goethe and Schiller and but little touched by the bustle of modern industry, met the constitutional convention which in 1919 framed the new republican constitution for Germany and marked a new epoch in its history. Here 423 delegates, including 37 women, elected by universal, direct, and equal suffrage, met and adopted a constitution which gave to the 60,000,000 German people, men and women alike, regardless of rank or birth, equality before the law, personal liberty, and equal economic opportunity.

Weimar, the capital of the recently formed German state of Thuringia, has well been called "the poets' city," for wherever we go we find reminders of the great men of letters who once frequented the narrow winding streets of the quaint old town, or trod the grassy paths along the pleasant river Ilm. The houses where Goethe and Schiller lived and wrote are preserved with loving care, and in a noble monument before the theater these two friends, the two greatest figures in German literature, are represented standing side by side. For nearly 40 years Weimar was the home of Franz Liszt, the composer and pianist. There are museums, art galleries, and a number of schools, but few industries. The city lies nearly at the center of Germany. Population, about 35,000.

WELDING. Brazed and soldered surfaces remain distinct, being merely cemented together by some other metal applied molten hot to the cold surfaces. Welded surfaces cease to exist; the welded joint, produced by heat and pressure, is a solid piece of metal. There are several welding processes, including forge, thermit, electric, and hot-flame welding.

A few years ago a British shipyard launched the first rivetless steel vessel. Shell, bulkheads, and floors were composed of steel plates welded to form one seamless structure, as if molded out of a single piece of steel—which illustrates the possibilities of the welding process.

You have perhaps seen a blacksmith welding two pieces of iron or steel on his anvil. This is the ancient method. The metal surfaces are first properly shaped, then heated in the forge to a semi-fused or pasty consistency. They must not be hot enough to burn or oxidize; therefore, while iron is heated white-hot, steel, which oxidizes more easily, can be heated only to redness. Then, after being dusted with a flux, such as sand or borax, to remove the scale or other impurities by uniting with them to form slag, the surfaces are hammered into union. Such "smith welding" is being superseded by the cheaper and quicker new processes.

There are several electric welding processes, which fall into two groups, one group using the heat of an electric arc, and the other heating the metal by its own resistance to the passage of an electric current. A resistance process invented by Elihu Thomson is the oldest and remains the most important. A large current (100 amperes even for a small wire, as high as 50,000 or 100,000 amperes for large castings) is used at low pressure (ordinarily two or three volts, occasionally four or five). The pieces to be joined are held in contact by clamps while the current is passed through. The ship mentioned above was electrically welded.

Of the hot-flame welding processes, the older hydrogen and oxy-hydrogen blowpipe processes (*see* Hydrogen) have been almost altogether displaced by the vastly more efficient and generally applicable oxy-acetylene process, now called "oxy-welding." The apparatus is practically the same as that employed in oxy-acetylene cutting (*see* Acetylene). It produces a perfect weld, in which the two parts of a joint of the same metal cannot be distinguished. It is used for rails, locomotives, pipes, and practically all forms of structural steel, and was extensively employed for repairs by the United States army during the World War.

WELLAND CANAL. From the central southwestern part of the Province of Ontario, a narrow hooklike point or peninsula thrusts itself eastward, separating Lake Erie, on its south, from Lake Ontario on its north. It long prevented men from sailing from one lake into the other. Although the Niagara River, dividing the peninsula from New York, links the lakes, its great cataract Niagara Falls bars continuous navigation. But today the voyage is easily made by the Welland Canal, on the Canadian or west side of the river. The commercial importance of this big ditch can scarcely be overstated, for it is one of the artificial links in the water chain for ships from Duluth or Chicago to the Atlantic Ocean (*see* Great Lakes).

From Lake Erie you enter the canal through the congested harbor of Port Colborne, where the eastbound traffic of the upper lakes converges for the overland journey to Lake Ontario, about 327 feet lower than Lake Erie. The canal, a "water stairway" about 27 miles long and 160 feet wide, makes the descent by means of 26 "steps" or locks, each 245 feet long, 45 wide, and 14 deep. The descent is about four times that of the Panama Canal (*see* Canals; Panama Canal).

Descending through one lock at Port Colborne, you glide 20 miles to Thorold through orchards and past the trim farmhouses and hedgerows of the rich and picturesque Garden of Canada, which is like a bit of old England. Progress is slow, for you must cautiously pass a dozen ships or more between lakes, some under foreign flags. The freighters carry chiefly agricultural products. From Thorold your boat climbs down lock by lock to Port Dalhousie on Lake Ontario, near St. Catharine's, Canada.

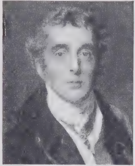
The Welland Canal is more than a waterway. It furnishes an inexhaustible supply of water for mills and manufacturing plants. First built and maintained since 1833 by Canada, the present canal is practically a new route built in 1870 to connect with the old. The increase of Great Lakes traffic and the resulting congestion in the canal prompted Canada in 1913 to start the "newest Welland," 30 feet deep and 200 wide, to accommodate an 800-foot vessel of 20,000 tons burden. The plans for this stupendous engineering work called for seven mighty locks to replace the former 26, and for an expenditure of $50,000,000. The World War interrupted the work, but it was resumed shortly afterward. (*See also* Sault Ste. Marie.)

WELLINGTON, DUKE OF (1769–1852). In the same year that Napoleon Bonaparte, the conqueror of Europe, was born in the little island of Corsica, another boy, Arthur Wellesley, who rose to be Duke of Wellington through his conquest of the conqueror, was born in Ireland. He was the fourth son of an Irish nobleman, the earl of Mornington.

We know very little about the early life of Arthur Wellesley (or Wesley, as the name was first written). He was a homely lad and evidently took very little interest in his books, either at the preparatory school at Chelsea or at Eton which he attended for a time. His mother, who never loved the boy, once said that "her ugly boy, Arthur, was fit food for powder and nothing else." Accordingly he was sent to the military school at Angers, France, where for a year he associated with French boys against whom he was later to fight.

At the age of 17 he entered the English army, and through the influence of his older brother, who was a member of the British House of Commons and of the government, his rise was rapid. By the evil custom of purchasing commissions he became lieutenant-colonel at the early age of 22, but his later achievements justified his advancement. In the hill country of India, from 1796 to 1805, he conquered hostile chiefs who had sworn to drive the English into the sea, and whose forces far outnumbered his own. And by the treaties which closed the war against these Mahratta tribes, Wellington showed himself a master of Indian statesmanship and diplomacy, as well as an expert on the field of battle.

In 1805 he quitted India for the larger field of the war with Napoleon in Europe. In his first campaign in the Spanish peninsula, which the French had overrun, he won a notable victory, the fruits of which were lost by the incompetence of his superior officers. The next year (1809) he came back to the peninsula as commander-in-chief, and in five momentous years drove Napoleon's well-trained generals from the Spanish peninsula. In 1814 he was fighting on French soil when Napoleon's first abdication brought peace. Finally on the field of Waterloo, with the aid of the Prussian general Blücher, he crowned his military career by defeating Napoleon himself.



WELLINGTON
The Conqueror of Napoleon

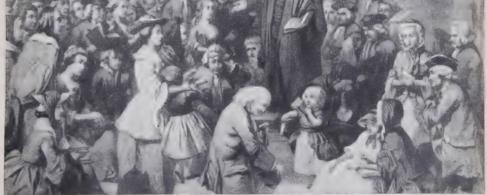
Honors, rewards, and gifts were now heaped upon the successful general, who was already created the first Duke of Wellington. As commander of the international army which occupied France until the terms of the peace treaty were fulfilled he had immense power, and for years he was one of the most influential men in all Europe.

Wellington proved less successful as statesman than as general, although for two years (1828–30) he was prime minister of Great Britain. He was an aristocrat who failed to read aright the signs of the times. The demand for the reform of parliament and the extension of the right to vote he thought was the work of a few uneasy agitators. Because he opposed the demand for reform he was forced to resign as prime minister and had to protect his house from the mob.

When the angry passions of the times had passed, people recognized that though Wellington was not always an able statesman he was a faithful and conscientious one, who always worked for what he believed to be the good of the nation. That and his great military glory made him in his old age venerated and beloved by all, the hero soldier of Great Britain as Nelson was the hero sailor.

WESLEY, JOHN (1703–1791). In the early part of the 18th century in Oxford, England, there gathered about John Wesley, then a young curate, and his brother

JOHN WESLEY PREACHING AT AN OPEN-AIR MEETING



When Wesley began to preach the doctrines of Methodism he found the doors of the churches closed against him. At first, he said: "I could scarcely reconcile myself to this strange way of preaching . . . . having been all my life (till very lately) so tenacious of every point relating to decency and order, that I should have thought the saving of souls almost a sin, if it had not been done in a church." But it was not for long that he hesitated and for the greater part of his active preaching career he held meetings outdoors where all kinds of people thronged to hear his message.

Charles, a student at Christ Church College, a group of young men who came to be known as the "Holy Club." Their strict rules of conduct, and the methodical way in which they performed their religious duties, led to their being called in derision "Methodists." Thus originated the name which came to be applied to the great religious sect which John Wesley founded.

John Wesley was born at Epworth, Lincolnshire, where his father was a rector of the Church of England. He was educated at Oxford, ordained a deacon in the church in 1725, and two years later became his father's curate, or assistant. In 1735, accompanied by his brother, he went to America as missionary to Georgia. On the stormy voyage a deep impression was made on him by the calm faith of some simple-hearted Christians from Moravia (a part of the Austrian Empire) who were his fellow-passengers. He studied their doctrines, and it was at a Moravian meeting in London after his return from his mission, that he felt his heart "strangely warmed" and there came to him a firm conviction of the saving power of Christ. He began preaching his new faith, and when he found the churches closed against him joined George Whitefield, a celebrated revivalist, in holding open-air meetings. Wesley's energy was amazing. He traveled about 5,000 miles a year and preached about 15 sermons a week. In spite of opposition and persecution, the meetings were attended by thousands and the movement spread rapidly. Wesley organized his converts into bands for prayer and church societies, appointed leaders to act as lay pastors, and finally ordained or commissioned preachers. This amounted to a break with the Church of England, although it was not recognized as such by Wesley himself.

In addition to the work of preaching and organizing, John Wesley was an active helper in social and charitable movements, and wrote a number of works on religious subjects. His 'Journal', which gives an account of his life and work, has been called "the most amazing record of human exertion ever penned by man." He was as methodical in his private life as in religion, regularly retiring at ten and arising at four.

Charles Wesley (1707–1788), who was associated with his brother in religious work, is best known as a hymn writer. He wrote about 6,000 hymns, many of which remain favorites in Protestant churches. Among the best known are 'Jesus, Thy Robe of Righteousness' and 'Blow Ye the Trumpet, Blow'.

WEST INDIES. Americans do not have to cross thousands of miles of stormy waters to discover foreign lands and languages and people. For in the Atlantic ocean right between North and South America an archipelago with hundreds of tropical islands gives them charming bits of England, France, Spain, Holland, Denmark, and even Africa transplanted to western waters.

The West Indies, the first part of the New World to challenge Columbus, in 1492, have ever since been the scene of adventure and troubled history. They curve like a great sickle, whose handle is Cuba, from Florida to Venezuela around the waters of the Caribbean Sea. All of them—the Bahamas, that beautiful irregular group of low coral islands lying southeast of Florida, the Greater Antilles (including Cuba, Haiti, Jamaica, and Porto Rico), and the Lesser Antilles, the last two groups making that long curve of mountainous volcanic islands that sweeps east and south along the Caribbean Sea down to the mouths of the Orinoco—were settings for strange scenes in the days of long ago. Not only were they the first parts of the New World to be discovered and settled; they were explored by mail-clad Spanish conquistadores who made them the base for their expeditions of conquest and exploration on the mainland; they were the stage for tragic hurricanes, pestilence, and—worse—the introduction of slavery; they were warred over by countries across the sea; and at various intervals they were the mighty strongholds for wreckers, blockade-runners, fierce pirates, and buccaneers.

When Columbus came to these islands they were swarming with copper-colored natives whom he left unharmed but who were later enslaved and practically exterminated by the dominating Spaniards. Today two-thirds of the archipelago's population of a little more than 6,000,000 are negroes or of negro descent. The whites are chiefly descendants of Spanish, French, and English settlers. Chinese and Indian coolies have come in in small numbers.

Columbus named these islands "the West Indies" because he thought he had reached a part of India. Their total area is about 92,000 square miles, the Greater Antilles alone taking up over 82,000 square miles. Of these Greater Antilles, Cuba and Haiti are independent, Porto Rico belongs to the United States, and Jamaica to Great Britain. Most of the other islands are British possessions, though a few belong to France and the Netherlands, and the larger Virgin Islands were purchased by the United States from Denmark in 1917. The West Indies have a tropical climate and vegetation and although all sorts of birds, snakes, lizards, scorpions, and insects abound, there are but few large mammals. There are forests of valuable lumber but agriculture is the chief industry. The chief trade is in sugar, fruit, and tobacco. (*See* articles on chief islands and groups.)

WESTMINSTER ABBEY. The pillared aisles of Westminster Abbey, the pointed arches, fluted columns, and beautiful rose window filling this world-famous church with a "dim religious light" form an impressive background for the wilderness of tombs and monuments found in England's great "temple of fame." As we walk among them the words of Francis Beaumont come to us:

> Mortality, behold and fear!
> What a change of flesh is here;
> Think how many royal bones
> Sleep within these heaps of stones:
> Here they lie had realms and lands,
> Who now want strength to stir their hands
> Here's an acre sown, indeed,
> With the richest, royallest seed.

As burial here is one of the great honors England bestows upon her sovereigns and greatest sons, many indeed are the mighty dead who slumber in this old Gothic church by the Thames. Close around the shrine of Edward the Confessor are sepulchers of various kings and queens. And in Henry VII's elaborate chapel, "the most gorgeous of mausoleums," along whose sides are the lofty richly carved stalls of the Knights of the Bath, stand the sepulchers of its founder, of haughty Queen Elizabeth, of the lovely unfortunate Mary Queen of Scots, and of many another famous member of royalty and nobility.

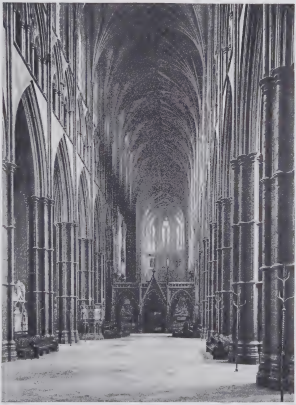
Courtiers, statesmen, soldiers, theologians, actors, artists, scientists, and musicians—all may be found in this "mansion of shadowy honors." And in the south transept, near the resting place of many famous men of letters, is the Poet's Corner, whose gray walls are lined with tablets, busts, and monuments of England's well-loved poets. Here is the marble tomb of genial Chaucer, the father of English poetry, over which is a memorial window with a picture of the Canterbury Pilgrims. Near the bust of Shakespeare's fellow-poet, "rare Ben Jonson," lies "the gentle Spenser, Fancy's pleasing son." Although he died in misery yet he had a brave funeral, and many men of genius of his day threw their poems to be buried with him. And not far from the burial places of Tennyson and Browning is the bust of Longfellow, the one American poet represented in "England's Pantheon of genius." Gay's monument with its mocking epitaph, inscribed there by his own request—

> Life is a jest, and all things show it,
> I thought so once, but now I know it—

strikes a different note from the epitaphs of the many other poets represented here; particularly from the beautiful lines carved upon the scroll carried by the statue of immortal Shakespeare, who from his niche looks serenely down upon his fellow poets:

> The cloud-capped towers, the gorgeous palaces,
> The solemn temples, the great globe itself,
> Yea, all which it inherit, shall dissolve
> And, like this insubstantial pageant faded,
> Leave not a rack behind.

WHERE SLUMBER THE MIGHTY DEAD



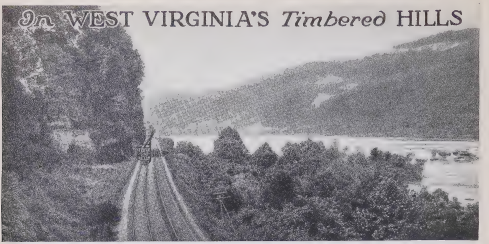
The great nave of Westminster Abbey is 101 feet 8 inches high. Its towering stone columns and its magnificent stained glass windows give it an air of true grandeur, thoroughly in keeping with its historic importance. The nave was under construction for nearly two centuries, being completed shortly before 1500.

The venerable Abbey has witnessed many a brilliant coronation scene; from William the Conqueror onward every sovereign—excepting Edward V— has here been crowned. In the Chapel of Edward the Confessor still stands the coronation chair containing beneath its seat the ancient Stone of Scone brought from Scotland, which tradition says was the stone that Jacob used for a pillow.

Westminster Abbey was originally the church of an old Benedictine abbey built in the 7th century. The foundation became important when in 1049–65 Edward the Confessor built a church on the present site, dedicating it to St. Peter. This was reconstructed in the 13th century, and later there were made numerous additions (including Henry VII's chapel of the 16th century and the two west towers by Sir Christopher Wren and Hawksmoor of the 18th century). The abbey, whose official name is the Collegiate Church of St. Peter, is 423 feet long. The towers rise 225 feet.

Among many others of England's famous sons represented by tomb or memorial in the abbey are: Milton, Coleridge, Burns, Samuel Johnson, Macaulay, Dickens, Livingstone, Darwin, Sir Isaac Newton, Pitt, Fox, and Disraeli.

In WEST VIRGINIA'S *Timbered* HILLS



The Famous Sandstone Rapids in New River, West Virginia

Extent.—East to west, 265 miles; north to south, 240 miles. Area, 25,000 square miles. Population (1920 census), 1,463,701.

Physical Features.—Allegheny Mountains (Spruce Knob, 4,860 feet) extending from northeast toward southwest in parallel ranges and breaking into disconnected knobs and spurs in the south; Cumberland plateau, broad rolling hills sloping to the valley of the Ohio which forms the northwestern boundary. Principal rivers: Potomac and its South Branch; Ohio and its tributaries the Monongahela, Little and Big Kanawha, Guyandotte, and Big Sandy.

Products.—Coal, natural gas, petroleum, clay, stone; corn, wheat, oats, hay, tobacco, potatoes, and fruit; cattle, horses, sheep, hogs; lumber and timber products, iron and steel goods, tin plate, glass, leather, flour and meal, brick and pottery.

Chief Cities.—Wheeling (55,000), Huntington (56,000), Charleston (capital, 40,000), Clarksburg (28,000).

WEST VIRGINIA. Mountain-walled and mountain-ribbed, West Virginia claims the title of the "Switzerland of the United States." Like its Old World namesake, the state has many climates. A vertical range of altitude from 260 feet above sea-level at Harpers Ferry to 4,860 feet at Spruce Knob is the equivalent of a range of 15 degrees latitude, and this gives West Virginia the climate and products of Virginia, New England, and southern Canada. There is said to be more sunshine in West Virginia than in Florida, and less snowfall than in Ohio or Illinois. Yet in some parts of the state there is frost in June, and frozen soil can be found all summer in some of the laurel thickets and spruce forests.

Unlike Switzerland, whose greatest wealth is in the magnificent scenery that draws thousands of visitors annually, West Virginia has vast treasure locked up within its mountains. Its coal alone is worth more than all the gold and silver of the Pacific coast.

Over two-thirds as large again in area as the Swiss republic, the "Little Mountain State" even on tiptoe cannot touch Switzerland's shoulder; Spruce Knob is scarcely a third as high as Monte Rosa. Still the average elevation of the state (1,500 feet) is greater than that of any other state east of the Mississippi.

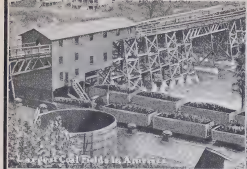
Neither lakes nor glaciers nor yet snow-capped peaks has West Virginia, though it is impossible to forget Ice Mountain, a huge natural refrigerator of porous sandstone, at the western base of which thick ice can be found all the year round.

In variety, if not in number, the mineral springs of West Virginia rival those of Switzerland, including, as they do, sulphur, chalybeate, carbonated, saline, and aluminated chalybeate, and thermal waters of high temperature. Berkeley Springs was known to George Washington; it and Capon Springs are owned by the state through bequest of Lord Fairfax. Red Sulphur Springs, too, was a watering place before West Virginia was a state. Greenbrier White Sulphur Springs is known as the "Saratoga of the South."

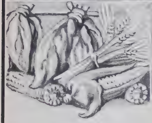
Generally speaking, the state falls into two divisions: the western plateau, drained into the Ohio by the Guyandotte, the Great and Little Kanawha and lesser streams, and the higher Appalachian region to the east, where the plateau is crumpled into mountain ridges and valleys as though by the grasp of a giant hand.

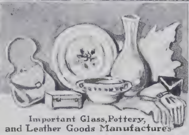
Travel over these steep slopes in pioneer days was even more difficult than travel in colonial tidewater Virginia. Wheeled vehicles were almost unknown; the only method of transportation was by pack animals, a fact perhaps fossilized in local speech, for what a Northerner "carries" and some Southerners "tote," a West Virginian mountaineer "packs." Each pioneer clearing was compelled to be as economically self-sufficient as a Virginia plantation, but on a different basis, for the West Virginia pioneer seldom had slaves. Practically all food was home-grown; most of the articles used were home-made—wooden bowls and plates for the table, wooden plows and other implements for

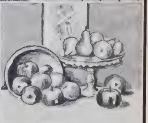
SCENES AND PRODUCTS OF WEST VIRGINIA


Largest Coal Fields in America

A Leading Source of Natural Gas [illegible]


Corn, Grain, and Tobacco


Important Glass, Pottery, and Leather Goods Manufactures


Pears and Peaches

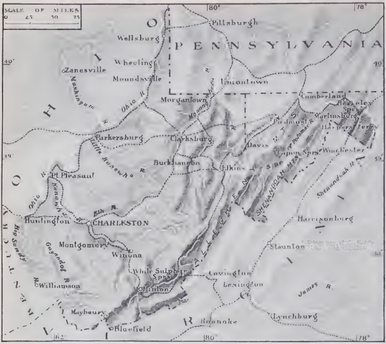
Rich in Hardwood Resources

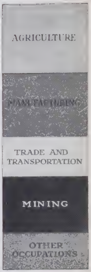
[illegible] Hall [illegible] West Virginia [illegible]

Hardy Horses of Wide Fame

West Virginia's products give the state an importance all out of proportion to its size. In mineral products it is one of the five leading states, with enormous outputs of coal, petroleum, and natural gas. The state also is an important producer of clay and clay products. The varied mineral resources quite overshadow agriculture in annual yield, though the busy little state is a prolific source of grain, tobacco, fruits, and live stock, particularly horses. Lumber also figures large, and places the state among the leaders of the nation in output of cherry, chestnut, oak, and yellow poplar timber. The natural products are the basis of varied industries, and thereby afford support to many busy manufacturing communities. Lumber and timber products, leather, iron and steel, glass, pottery, and coke are leading items.

THE RUGGED LAND OF "AMERICA'S SWITZERLAND"

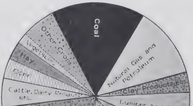

SCALE OF MILES
0 25 50 75
OHIO
PENNSYLVANIA
Pittsburgh
Wellsburg
Wheeling
Zanesville
Moundsville
Uniontown
Muskingum R.
Ohio R.
Morgantown
Monongahela R.
Cumberland
Berkeley Sprs.
Martinsburg
Harpers Ferry
Piedmont
Potomac R.
Parkersburg
Clarksburg
Davis
Capon Sprs.
Winchester
Little Kanawha R.
Buckhannon
Elkins
Pt. Pleasant
Kanawha R.
Elk R.
Shenandoah R.
SHENANDOAH MTS.
ALLEGHENY MTS.
Huntington
CHARLESTON
Harrisonburg
Big Sandy
Guyandot R.
Montgomery
Winona
Staunton
White Sulphur Sprs.
Covington
Williamson
Hinton
Lexington
James R.
Mayberry
Bluefield
Roanoke
Lynchburg
80°
78°
40°
39°
38°
KENTUCKY
VIRGINIA



The map shows clearly how West Virginia is a land of tumbled mountains and twisting rivers, with the Allegheny ridge as backbone. The chart below compares the leading occupations of the people.

the farm. When it became absolutely necessary to have things that could not be obtained from the fields or the woods or made by the pioneer and his family—or things like salt, iron tools or other manufactured articles—a neighborhood would load a caravan of pack-horses with peltries, ginseng, and bear's grease and send it down to trade at the nearest market.

This difficulty of transportation naturally delayed the development of agriculture and other resources of the state. The steam thresher and other improved farm machinery did not come into use until 1880. To be sure, more than half the state is over 1,500 feet in altitude (a large area over 2,000 feet) and hence less adapted to crops than to stock-raising and lumbering. The western (lower) part grows corn, buckwheat, rye, oats, tobacco, and sugar-cane (for molasses, not sugar); the eastern (higher) part produces more live stock. West Virginia is especially adapted to raising hardy horses. In some eastern markets, it is said, the best recommendation a horse can have, next to being a good animal, is to have been born and bred in West Virginia. Cattle, sheep, and hogs are also raised.



This graph shows the relative value of West Virginia's products. Notice the great importance of minerals.

Here, as in New England, the hillsides have been found well suited to orchards. Grimes' Golden apple originated in West Virginia, which is also an important peach-growing state.

But West Virginia's most important resources, ranking ahead of farm products, are coal, petroleum, and natural gas. Coal underlies nearly two-thirds of the state. Some of the coal lies 1,300 feet deep, to be sure, but nearly all English coal is raised from a depth of 1,000 to 3,000 feet. West Virginia coal is remarkably free from sulphur and other impurities, and the beds include many varieties—anthracite, bituminous, and one of the largest known areas of pure cannel. The state's great range of altitude is most advantageous in coal-mining, for it drains the mines of water and gas and permits coal to be hauled from the mines by gravity.

The social conditions of the coal-mining region are just the opposite of those of the agricultural part of the state. The farming population is almost all white (99.2 per cent) and of American stock. Most farmers own their farms. West Virginia keeps the key to her granaries, but the key to the coalbins in the cellar is in other hands. Much of the coal land is owned outside the state, and an increasingly large number of foreigners have been drawn in as miners. Most of the coal is used in other states.

West Virginia was long a leader among the states in the production of natural gas, and crude petroleum is also an important product. The production of oil and gas in the whole Appalachian field, however, has been displaced from national leadership by the rise of the Oklahoma, Kansas, California, and Texas fields. Most West Virginia oil is piped to Philadelphia and Baltimore, and most of the gas to the cities of the state and to Cleveland and Pittsburgh. Among other mineral products are fire clay and potter's clay, salt (drawn from brine wells), glass sand, grindstone, black slate, limestone for cement and fertilizers, and a large variety of building stones. Iron ores are found but are not largely worked at the present time.

Much timber has been cut but large hardwood forests are still untouched. The state is a prominent producer of cherry and chestnut, with oak and yellow poplar coming next in amount.

The manufactures are chiefly in the northern part of the state along the Ohio River, where both shipping facilities and fuel (coal and natural gas) are accessible. They include iron and steel, lumber products, flour and grist, tinplate, coke, and glass (in the last of which West Virginia ranks next after Pennsylvania), pottery, brick, leather and leather goods. Six cities—Wheeling (the chief city—population 55,000), Huntington, Charleston (the capital), Parkersburg, Martinsburg, and Benwood—contain nearly a third of the manufactures of the state. Morgantown is the seat of the state university. The population is over 1,400,000, or over a third that of Switzerland.

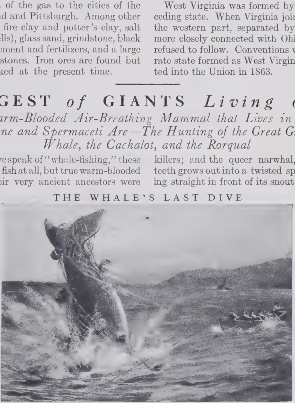
West Virginia was formed by secession from a seceding state. When Virginia joined the Confederacy, the western part, separated by the mountains and more closely connected with Ohio and Pennsylvania, refused to follow. Conventions were held and a separate state formed as West Virginia, which was admitted into the Union in 1863.

The HUGEST *of* GIANTS *Living or Dead*

The Strange Warm-Blooded Air-Breathing Mammal that Lives in the Sea—What Whalebone and Spermaceti Are—The Hunting of the Great Greenland Whale, the Cachalot, and the Rorqual

WHALE. Though we speak of "whale-fishing," these animals are not fish at all, but true warm-blooded mammals. That their very ancient ancestors were land animals we know from their skeleton and other parts; it is especially evident in the very young ones, which are born alive and are fed with mother's milk, like land mammals. Under the zoölogical name *Cetacea*, or cetaceans, are grouped not only the huge true whales but their smaller relatives the dolphins, about which were woven so many ancient fables; the sportive porpoises, familiar to all who sail the seas; the grampuses or blackfish, hunted for their oil; the white whales, one kind of which is often seen in the lower St. Lawrence River; the savage killers; and the queer narwhal, one of whose front teeth grows out into a twisted spearlike tusk stretching straight in front of its snout to the length of four or five feet.

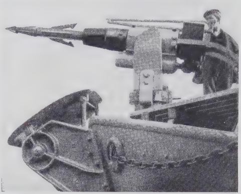
THE WHALE'S LAST DIVE



A harpooned whale generally plunges in terror, sometimes carrying down 1,000 feet of line or more. If the boat's crew should let the line become entangled so that it does not run out as fast as the maddened creature draws it, the boat, too, will be pulled under water. After a time the whale must come up to breathe, and then it will be dispatched.

In all these animals the shape has become fishlike in accordance with the fishlike manner of life. The skin is smooth, with a few traces of hairs, and usually black, or black and white, or sometimes all white. The hind limbs have disappeared, a powerful flat tail doing their work in swimming; and the fore limbs have become paddles. These have the same bones as in our arms, but much shortened; while the fingers are greatly lengthened and inclosed in a mitten of flesh making the "flippers." As whales have lungs (not gills) and breathe air, they must come to the surface every half-hour or so for that purpose. At the instant they emerge the pent-up air is expelled from the lungs through the nostrils at the top of the nose. In the case of the larger species this big discharge of moist breath condenses in the cold air into a visible vapor, often mixed with sea-spray, which is called a "blowing"; but no water is expelled from the mouth. The nostrils are connected directly with the windpipe, so that whales can swim with their mouths open without strangling. The smaller kinds of cetaceans, of which the variety is immense, are in the main fish-eaters; but the killer seizes and devours porpoises and seals also, and a band of them may unite to worry a big cachalot (sperm-whale) to death. Most whales go about in small bands, or "schools."

THE DEADLY HARPOON GUN



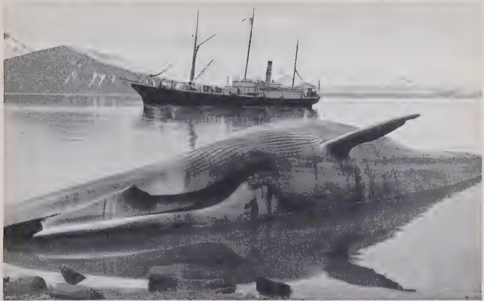
Until the invention by a Norwegian of the harpoon gun, in 1865, the largest and speediest whales often escaped the fishermen. But the new device, which you see here, made whaling far more deadly for the whales and correspondingly safer for the whalers. The great dart with cable attached is fired from the gun, and after it penetrates the whale a powder charge contained in the cap at the tip explodes, usually causing instant death.

The "great" whales are of two distinct families: (1) baleen whales, and (2) toothed whales. The most hunted species of the first class, the right whales, have blade-shaped plates of horny material (whalebone or baleen) hanging in regular rows from the roof of the mouth to the number of two or three hundred, those in the center being 8 or 10 feet long. Right whales are huge creatures, often 50 to 75 feet long; they range through all oceans, even amid Arctic ice, and occasionally cross from one side to the other of the North Polar Sea. Nevertheless, despite their enormous bulk and power, these whales subsist altogether on the shrimp-like crustaceans and other minute creatures that crowd the surface of the ocean, especially in cold latitudes. These are swept into the whale's mouth by the million as it rushes along, the water flowing out of the sides of the mouth, and the food being caught by the fringes of the baleen and sucked down like a continuous meal of soup. In addition to whalebone obtained from these whales, the hunters cut away and save the thick layer of fat (blubber) underlying the skin and surrounding the body in a warm blanket, from which oil is extracted. The beef-like flesh of the whale is good meat, and it is coming more and more into market, especially on the Pacific coast. Similar to the right whale are the humpback, the gray-back, the fin-back or rorqual, etc. The smallest is the New Zealand right whale, 20 feet long.

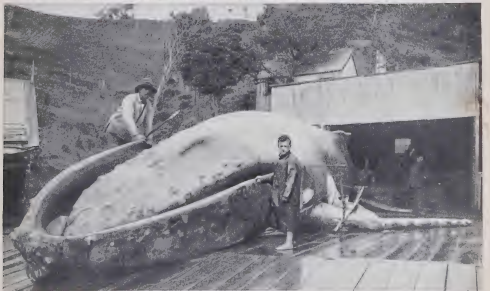
A HARVEST OF WHALES OFF SPITZBERGEN

The seagulls are flocking hungrily about to await the cutting up of the fine catch of whales moored to the stern of this Norwegian whaler. The Norwegians, who have been whale-fishers since the 9th century, have whaling stations on the coast of Iceland, on the Faroe, and Shetland Islands, and elsewhere throughout the far north.

WHALE-FISHING AT OPPOSITE ENDS OF THE EARTH



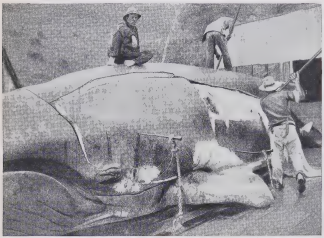
The Fin-Backs or Rorquals are the commonest of all whales, being found in the Atlantic and the Pacific, from Iceland to New Zealand; this one was taken in Spitzbergen waters. The whalebone of the Rorqual, one plate of which can be seen in the mouth of the stranded whale, is coarser and shorter than in any of the other baleen whales, and the blubber is scantier; hence the Rorqual has been little hunted until recent improvement in whaling methods and decrease in the numbers of other species have given it greater importance.



One of the most remarkable of all whales is the Humpback, with its scow-shaped lower jaw, its flat lumpy upper jaw, and its small body so clumsily joined to the huge head and thorax. It presents a contrast to the slender graceful rorqual in the great length of its fins as well as in its general shape. The hump is the prominence (sometimes, as in this specimen, very slight) where the back fin joins the body. The white circles on its dark skin are the marks left where barnacles have been rubbed off. The Humpback is found in schools and hunted in all oceans. This whale was landed at Whangammon Whaling Station, New Zealand.

The largest of the whales, the blue rorqual, or "sulphur-bottom" of the Pacific Ocean, is said to be not only the largest living animal but the largest animal that has ever lived. It reaches a length of 88 feet or more and an estimated weight of at least 75 tons. A calf, whose mother was 80 feet long, was 25 feet long at birth and weighed about 8 tons. From the rate of growth of the large whales, it is estimated that the calves are able to take care of themselves in about six or eight months.

STRIPPING OFF THE BLUBBER BLANKET



In the old whaling days, a killed whale was made fast to the side of the ship, and some of the crew, in spiked boots, swarmed over the carcass, cut off 20- and 30-foot strips of skin, and with blubber spades dug out half-ton chunks of blubber, which were hoisted on deck, tried out, and stored in casks. Nowadays the carcass, inflated with air if necessary, is towed rapidly in to a shore whaling station like this one in New Zealand, where the work is done by special crews.

The toothed whales comprise the sperm whale or cachalot, its lesser cousin the cogia, and the small "beaked" whales of the Antarctic region. All are more numerous within the tropics and in the South Pacific than elsewhere.

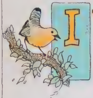
The sperm whale, which reaches a length of 60 to 70 feet, differs in form from a right whale mainly in having a great flat-topped, almost square-fronted head making up one-third of his length. Beneath the head is hinged a thin and somewhat shorter under-jaw, and the animal must turn on its back to seize a fish, much after the manner of a shark. The cavernous mouth is armed with strong pointed ivory-like teeth eight or ten inches long; for these whales are hunters of squids and cuttlefish especially, with such fish as rock cod for second choice. The teeth are not adapted to mastication, but they can bite big fish or seals into manageable pieces. The timbers of more than one whaling boat, attacked and demolished by the furious rush of a maddened sperm whale, have been chewed and crushed to matchwood in its massive jaws. The cachalot is probably the only creature that dares attack the giant squid, which, with its outstretched arms, measures as great a length as himself; and the mark inflicted by the squid's winding arms and cruel suckers are often seen on the hides of captured specimens as scars of struggle between these Titans of the deep. The value to man of the sperm whale lies chiefly in the liquid fat that fills a vast cavity in the top of the head, a single whale yielding many barrels of it, from which the valuable substance spermaceti and a fine oil are extracted. In their intestines are frequently found lumps of the fatty secretion called "ambergris," used as a base in the making of perfumes, and for which a high price is paid. As much as $60,000 worth of this substance has been taken from a single whale.

In the early days of whale fishing a sperm-whaling trip was a long one. Sailing ships were used, and were stocked for a three years' voyage or more. Six whale boats, each about 27 feet long and sharp at both ends, were carried on the ship. When a whale was sighted the boats were let down, each manned with a crew consisting of a boat-steerer, four rowers, and a headsman. The boat-steerer carried the harpoons, with which the whale was first attacked. The harpoons each carried a line, and when the boat was fast to the whale the attack was carried on by the headsman armed with slender lances. The maddened whale would drag the boat with lightning-like speed through the water and would often "sound" or dive to the depths of the ocean, and the line would run out thousands of feet. Sometimes the whale would stay beneath the water for an hour, but need of air would eventually bring it to the surface, usually to be killed by a lance thrust in a vital spot. The whale was then towed to the ship, the blubber cut off and tried out, the spermaceti, the waxy substance obtained from the oil in the head, was ladled out of the great cavity and put in casks, where it solidified. A large sperm whale yielded as much as 80 barrels or about 3 tons of oil.

Today most whalers are staunchly built iron steamers, and the boats are armed with a cannon-like harpoon gun mounted on a pivot at the bow. This gun discharges a 5-foot harpoon, weighing more than 100 pounds, into the body of the whale. Screwed to the top of this harpoon is a hollow iron cap filled with blasting powder and a time fuse discharges the bomb in the body. The harpoon carries a stout cable which is usually handled from the ship by a great windlass. This method of capture, while lacking the old-time thrills, makes possible the capture of the larger whales which often could not be taken in the old way.

TALES THE WOODMAN TOLD

HOW THE WHALE LEARNED TO SMOKE



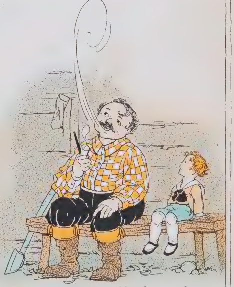
IT WAS spring again. The Little Boy sat on the bench in front of the log cabin where the Woodman lived, and he could hear and see the spring signs in the woods all about him. The little twigs of the trees were tinged with warm color, and the buds were bursting with new life. A woodpecker was beating a tattoo for joy on an old dead trunk, and the sugar birds were calling to their mates *twee-twee-e-e, twee-twee-e-e!* For some time Little Boy had been thinking. At last he said:

"Mr. Woodman, I bet there's one kind of animal you don't know much about."

"Well, maybe so," said the Woodman cautiously; for he was wondrous wise, and also very modest. "But what is it?"

"A whale!" cried the Little Boy; and he clapped his hands with glee, for he thought that *now* he had the Woodman.

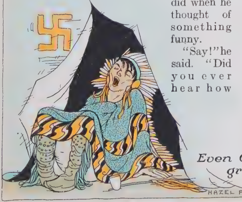
But the Woodman threw back his head and laughed. "A whale!" he said. "Why, my old granddaddy was captain of a whaler that sailed a dozen times out of New Bedford; and he used to tell me—"



— and blew a puff of smoke high in the air

He stopped and chuckled, and his eyes got all crinkled up as they did when he thought of something funny.

"Say!" he said. "Did you ever hear how the whale learned to smoke?"



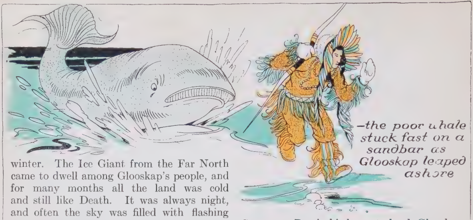
Even Glooskap grew drowsy

"Learned to *smoke!*" cried the Little Boy; and his blue eyes grew round with astonishment. "Do whales smoke?"

"Sure!" said the Woodman, as he took the pipe from his own mouth and blew a puff of smoke high in the air. "Just like that! Every one of 'em. When I was working in a logging camp up in Canada, an Indian told me how it all began."

"Tell me the story," begged Little Boy, nestling closer to his big friend.

"Well," said the Woodman, as he put his arm around the Little Boy, "you know that Indian god—Glooskap—that the Indians tell such funny tales about. While he was living among the Indians there once came a terrible



—the poor whale stuck fast on a sandbar as Glooskap leaped ashore

winter. The Ice Giant from the Far North came to dwell among Glooskap's people, and for many months all the land was cold and still like Death. It was always night, and often the sky was filled with flashing quivering lights which spread from the North. Even Glooskap grew drowsy and for six months he slept in his tent. Then he roused himself; for he knew that unless something was done all his people would perish.

"Far away to the South he knew there was a wonderful land where it was always warm; and its radiant Queen could easily overcome the wicked Ice Giant, if only he could get her to come to his land.

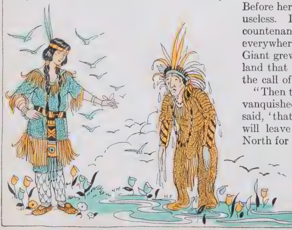
"Now the Whale was one of Glooskap's creatures, and he always carried Glooskap on his back when the god wanted to go journeying over the sea. So Glooskap called the Whale to the frozen shore, and they set out through the seas together. After many days they came to the Land Where It Is Always Summer. But in his haste to land, Glooskap guided the Whale into too shallow water; and there the poor Whale stuck fast on a sandbar as Glooskap leaped ashore.

"Presently Glooskap came upon the Queen of Summer, in a lovely valley filled with flowers and arching trees; and about her danced and sang a throng of fairy maidens. He told her his story and at last she agreed to accompany him back to his land.

"He did not dare to take the Summer Queen to his frozen home by water, so they traveled the long way by land. After many days they arrived and found Old Winter still in possession of the country.

"The grim Ice Giant tried his spells against the Summer Queen. But it was in vain. Before her radiant glance his frost charm was useless. Drops of water appeared upon his countenance, and soon rivulets were running everywhere from the melting snow. The Ice Giant grew smaller and smaller. And all the land that had been under his spell awoke to the call of Spring.

"Then the Summer Queen took pity on the vanquished Ice Giant. 'I have proved', she said, 'that I am more powerful than you. I will leave you all the country to the Far North for your own. You may come back to



The Ice Giant grew smaller and smaller

Glooskap's country five months of every year; and in between I myself will come from the South and rule the land'.

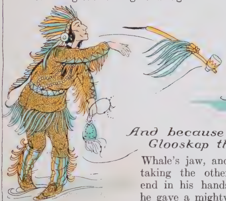
"And so that is the way," ended the Woodman, "that Summer and Winter have divided the year ever since."

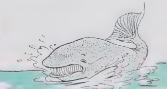
Here the Woodman got up to light his pipe, which had gone out while he talked.

"B-b-but—," stuttered the Little Boy in his excitement, "how did the Whale get off the sandbar? And how did he learn to *smoke*? You didn't tell me that part of the story at all!"

"That's so," said the Woodman as he sat down again, looking rather foolish.

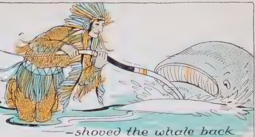
"Well, when Glooskap landed, he put one end of his great strong bow against the Whale's jaw, and taking the other end in his hands he gave a mighty push, and shoved the Whale back into deep water again. And because that hurt the Whale and made him angry, Glooskap threw him his old pipe, with its pipestone bowl and its long reed stem ornamented with feathers; and he also threw him a great big bag of Indian tobacco leaves.





And because that hurt the whale, Glooskap threw him his old pipe

"That pleased the Whale mightily; and as Glooskap watched him swim far out to sea he saw puffs of smoke rise from the Whale toward the sky. And I guess all the whales have pipes now, and have learned to smoke them; for every time a sailor sees one rise to the surface, he is sure to see it blow great puffs of smoke far up into the sky."

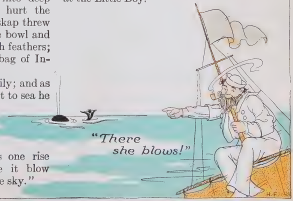


—shoved the whale back into deep water again

"Is that really *truly* true?" asked the Little Boy, suspiciously; for sometimes he thought the Woodman liked to play jokes on him. "Did your granddaddy that went on a whaler ever tell you that he had seen whales smoke?"

"Well, no!" said the Woodman sheepishly. "Fact is, I suspect it's just steam from the whale's breath that shoots up into the air that way. But every time an old sailor sees a whale at sea, he's pretty apt to holler out, 'There she blows!'"

And the Woodman blew a mighty puff from his own pipe as he looked down triumphantly at the Little Boy.



"There she blows!"

The GOLDEN GRAINS *that Give Us* OUR DAILY BREAD

Every Day of the Year Harvesting is Going on Somewhere in the Vast Wheat Fields of the World that Men May Have Their Staff of Life— An Industry as Old as Civilization—Enemies that Attack the Tender Plants

WHEAT. In North America wheat makes up one-fifth of the diet of the average family, and in European countries its importance is only slightly less. Its prominence over all other grains is due in part to the fact that it keeps and ships much better than corn, for instance, and also to the fact that no other grain combines so many valuable bread-making qualities. Wheat gluten is better adapted than that of any other grain to make a light porous raised loaf. People tire of the flavor of other cereals; that of wheat never palls. "He wants better bread than is made of wheat" is a homely proverb used of a man who demands impossible excellence.

When we think of all the people who wake up every morning hungry for bread, we wonder where all the wheat comes from to feed them. Farms little and big, scattered almost everywhere over the earth's surface, contribute to the supply. There are wheat fields up almost to the Arctic Circle in Canada and northern Russia, so that the great temperate zones of the Northern Hemisphere are covered year after year with golden seas of wheat. Wheat flourishes also on the high plateaus of Mexico and Chile, and it thrives in most parts of the temperate zones of the Southern Hemispheres, in South Africa, the Argentine Republic, and in far-off India and Australia. In fact, there are very few lands where wheat is not grown.

FOLLOWING THE WHEAT CROP AROUND THE WORLD

Wheat is being harvested somewhere all the time. Here is an interesting table which shows the time when the world's wheat crops are gathered.

January—Chile, New Zealand, Australia.
February and March—Upper Egypt, India.
April—Lower Egypt, India, Persia, Asia Minor, Cuba, Mexico.
May—Texas, Algeria, Morocco, China, Japan.
June—California, Utah, Oklahoma, Kansas, Arkansas, Missouri, Mississippi, Alabama, Georgia, South Carolina, North Carolina, Virginia, Kentucky, Tennessee, Spain, southern France, Italy, Greece, Turkey.
July—Washington, Oregon, Wyoming, Nebraska, Iowa, southern Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, Pennsylvania, New York, New England, southern England, Germany, southern Russia.
August—Montana, the Dakotas, central and northern Minnesota, Canada, England, Belgium, Netherlands, central Russia.
September and October—Parts of western Canada, Scotland, Scandinavia, northern Russia.
November—South Africa, Peru, northern Argentina.
December—New South Wales, Burma, Argentina.

The story of the cultivation of wheat is the story of the civilization of man. When man ceased wandering about in roving bands, relying for his food almost entirely on cattle and sheep and game; when he built a home, planted grain, harvested it, and stored it away for future use, then he had taken an important step from savagery to civilization.

We do not know what people first took this momentous step, but we do know that the cultivation of wheat was being carried on at the earliest times recorded in history. Wheat is mentioned many times in the Bible. Egypt cultivated it at a very early date in the rich valley of the Nile. The Chinese were growing wheat thousands of years before the Christian era, and they have a legend that it was a direct gift from Heaven to man.

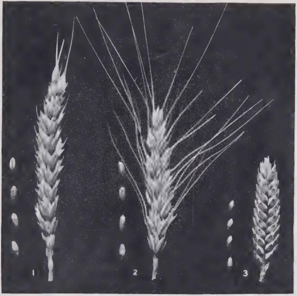
Wheat is a member of the grass family. Other members of the same family which are used for food are corn, rye, oats, and barley, but wheat is by far the most largely used. There are many varieties of wheat. Some of the wheat berries are harder than others. Some of the heads have long "beards," or hairlike spikes that cover the grain, and others are nearly beardless. In North America the most important classes are spring wheat and winter wheat. Winter wheat is planted in the autumn and starts to grow before winter. Spring wheat is planted in the spring.

Varieties of wheat must be carefully selected to suit the soil and climate where they are to be grown, soft starchy wheats being adapted to moist climates and hard glutinous wheats to dry climates. The flour from soft wheat is superior for pies and pastries, but that from hard wheat makes better bread, though, until the introduction of the gradual reduction roller process of milling, hard wheat did not make as white a flour as the soft starchy wheat and was therefore less prized. The roller process, enhancing the value of hard spring wheat, was largely responsible for the wheat boom of the Northwest and the shifting of the wheat-growing region from the Atlantic seaboard to Minnesota, the Dakotas, and western Canada.

The ground is prepared for wheat planting by plowing (*see* Plow). Then steel-toothed harrows go over it to break up the clods. Drill seeders follow the harrows and drop the seeds through pipes in little rows. Behind each pipe is a small plow like a garden trowel which covers the grain. Before the seeder came into use men carried bags of grain swung over their shoulder and sowed the seed broadcast, as in Millet's great picture of 'The Sower'.

Wheat, like most living things, has a hard struggle to live, because of its many enemies. In the spring the wheat plants must have rain, and at harvest time warm sunshine to ripen the grain. In dry summers chinch bugs feed on the young plants and kill them. In cool moist summers the Hessian fly lays eggs on the little plants, which hatch into destructive worms. Then there are rusts and smuts and other fungus growths which also do enormous damage (*see* Rusts and Smuts). Methods of fighting each of these pests have been discovered, and the farmer nowadays does not feel so helpless as he formerly did when he found them in his wheat fields. A great many things go to determine whether there will be a big crop or a small one; and everyone is very much interested, for it is important that there be plenty of wheat to make the flour for the world's bread.

VARIETIES OF WHEAT



The copious winter rains of the Pacific coasts are favorable to these three plump, starchy varieties of Spring Wheat: (1) Palouse Bluestem; (2) Early Baart; (3) Little Club. Since the chaff holds the grain tenaciously, the ripened wheat can stand without shattering in the dry summer.

The wheat grows rapidly, and in a few weeks it has "headed out" and grains of wheat fill the heads. When the grains first reach a fairly good size they are plump and soft and filled with a milky fluid. Later they become solid, but not hard. Slowly the plant loses its green coloring and changes to lighter hues. At last comes the golden yellow, which tells the farmer that the wheat is nearly ready to be harvested. A great field of golden wheat billowing in the wind, stretching away as far as the eye can see, is one of the most inspiring sights in nature. The wheat must be harvested at just the right time. If the grain is too ripe, much will be scattered and spilled in the field, and if it is not ripe enough it will not keep well. Farmers say the wheat is ready to be harvested when the wheat grain is hard enough so that it cannot be crushed, yet soft enough to be indented with the finger-nail.

This is the common Winter Wheat. Bearded wheats are considered hardier as a rule than the beardless varieties.

It is an exciting time on the farm when the wheat is harvested, and the work is very hard, although a great amount of the labor done formerly by hand is now done by modern machinery. First the grain is cut. In olden times and in many backward countries today men cut the wheat by hand with scythes or sickles, or with a device they call the "cradle." This is a large scythe which carries a framework to collect the grain as it is cut. Cyrus H. McCormick, an ingenious American, fastened a number of little scythes or blades to a shaft and made a wonderful reaping machine that cuts the wheat, gathers it in bundles with the heads all one way, and ties the bundles of grain (*see* Reaping Machines). The bundles are then stacked into shocks in the field so the sun will dry them, and they are left standing until the grain is ready to be threshed or separated from the straw. This is done by a big threshing machine, which is run by power furnished by a traction engine. In some of the big fields of the Northwest a wonderful combination binder and thresher is used. This cuts a swath of wheat, sometimes 30 feet wide, and threshes and sacks the cut grain as it travels slowly over the field (*see* Threshing).

After the wheat is threshed it is ready for the market. In every small town in the wheat-growing regions of the United States, there is a grain elevator to store and load wheat. Usually the farmer brings his grain to this elevator and sells it to a middleman, who in turn sells it to the great wheat buyers at the principal markets of the world. The price paid the farmer depends upon a number of things—the relative supply of and demand for wheat, the grade given his wheat by the official inspectors when it is marketed, the distance of his shipping point from the central markets, and so forth. While wheat is a profitable frontier crop because it keeps well, is easily shipped, and always and everywhere in demand, 30 miles seems to be about the extreme distance from a railroad that it may be profitably grown for shipment. The building of railroads across the unbroken plains of western Canada has opened up a new wheat region of enormous possibilities.

As a rule the country elevators have a capacity of from 8,000 to 20,000 bushels, although some are much larger. From these elevators railways haul the wheat to the great central markets at Duluth, St. Paul, Minneapolis, Chicago, and Buffalo, where immense storage elevators hold it until it is needed for milling and the export trade (*see* Grain Elevators).

The buying and selling of wheat for future delivery has given rise at various places to speculative markets. The most famous of these in this country is the Chicago Board of Trade, where buying and selling of all sorts of grain goes on in various "pits" (*see* Board of Trade). The great world wheat market is Liverpool and it is to this port that most of the export supply of wheat goes.

The Wheat Growers of the World

A country is counted as an important wheat country when it produces more wheat than it uses, so that it has a surplus for export. The United States ranks first among wheat-growing countries, both in total production and in exports, though in some years Canada leads in exports.

Before the World War Russia was first in exports, raising enormous crops in its famous "black earth" belt, but it now grows little more wheat than it consumes. Rumania and Bulgaria too were once great exporting countries, but now they have little to spare. Hungary and Jugo-Slavia in some years have a small surplus for export. All other European countries have to get some of their wheat abroad, and the British Isles, Belgium, Holland, Switzerland, and Scandinavia depend mainly on imports.

The United States raises from one-fourth to one-fifth of all the wheat grown in the world, with an average crop of about 800,000,000 bushels. Canada, Argentina, Australia, and India are the only other countries of importance in the world's wheat trade.

Australia produces only about as much wheat as Kansas, but she exports large quantities because her small population consumes much less. The Argentine Republic is the greatest wheat-producing country of the Southern Hemisphere. It has countless acres of tillable and highly productive land, and easy access across the Atlantic to the great European market centers. The northwest provinces of Canada are also adapted to the growing of the finest quality of wheat on a grand scale, with great still undeveloped tracts in Alberta and Saskatchewan. Wheat is also grown in nearly all parts of Asia, but because of the amounts consumed by the great home populations and because of the primitive method of production, Asiatic Russia and India are the only Asiatic countries of world importance in the export trade. The wheat area of India is approximately one-ninth of that of the entire world, but only very crude machinery and primitive methods are used. However, the people of India live largely on rice and millet, so a large percentage of their wheat is exported.

Various factors are capable of increasing the world's wheat yield if necessary. Among these are: the enlargement of the wheat-producing areas, either through the opening up of undeveloped territory or through the production of new varieties of wheat adapted to regions as yet unproductive; increase of yield through more productive varieties, use of fertilizers, and more thorough methods of cultivation; and more extensive use of machinery. Northwestern North America, Siberia, and to some extent possibly South America are the most important regions where enlargement of area is possible. The introduction of the drought-resisting durum wheat into the United States has made it possible to raise wheat in parts of the West which were too dry for other kinds of spring wheat. The farm tractor, by increasing the acreage farmed per man, has lowered the cost of wheat production and made it profitable to farm land which otherwise would not pay for cultivation.

The ordinary cultivated wheat plant, *Triticum sativum vulgare,* is a tall slender annual or biennial plant, belonging to the group of cereal grasses. It has a hollow erect knotted stem, bearing at its summit a zigzag-shaped ear which has a number of flattened spikelets growing out of each notch. These spikelets usually bear four flowers each, which produce the fruit or grain. The grain is hard, seedlike, and grooved lengthwise along one side. There are many varieties. For practical purposes the wheats are usually classified as winter wheat and spring wheat, with soft and hard varieties of each, bearded and beardless, and white, red, and amber.

"Spelt" wheat (*Triticum sativum spelta*) was grown by the ancient Romans and the Egyptians. Kernels of this wheat thousands of years old have been found in mummy-cases. This variety is still grown in cold mountainous districts of Europe and produces a very fine flour for pastry-making. Other varieties are: dwarf or club wheat (*Triticum sativum compactum*); English wheat (*Triticum sativum turgidum*); Polish wheat (*Triticum polonicum*); hard, durum, flint, or macaroni wheat (*Triticum sativum durum*), which is grown chiefly in Mediterranean countries for macaroni-making; emmer (*Triticum sativum decoccum*); einkorn (*Triticum sativum monococcum*). Ninety per cent of the wheat grown in the United States is of the common type; club, durum, and emmer are the only other types extensively grown. (*See* Bread; Flour.)

WHIPPOORWILL. Have you ever *seen* a whippoorwill? Few people have, yet almost everyone knows his call, the three whistled notes—"whip-poor-*will*, whip-poor-*will*, whip-poor-*will*"—that gives him his name. Whippoorwills are night birds, and their noiseless flight adds an uncanny touch to the mystery of the plaintive insistent call that echoes through the dusk of early night and dawn.

John Burroughs, the great naturalist, writing of the whippoorwill says: "One April morning between three and four o'clock, hearing one strike up near my window, I began counting its calls. This bird laid upon the back of Poor Will 1,088 blows. Then it stopped about half a minute, and began again, uttering this time 390 calls; when it paused, flew a little farther away, took up the tale once more, and continued till I fell asleep."

In the daytime this bird sleeps on the ground in deep woods. Here its dull mottled feathers are not noticeable, and even the trained eye of the naturalist has difficulty in discovering it among the leaves and grasses. It is about the size of a robin, with a rounded tail and a short thick neck; and it has a cat-whisker-like growth about its wide mouth that helps it to catch the insects on which it feeds. (For illustration in colors, *see* Birds.)

THE MYSTERIOUS NIGHT CRIER

A shy and modest bird is the Whippoorwill; but it is also a persistent creature; hour after hour it keeps pleading in the darkness for someone to "Whip-Poor-Will." While its beak is very short, its mouth is very large, permitting the bird to scoop up insects as it darts through the night air.

Whippoorwills summer in Canada and in the United States as far west as Nebraska and Kansas and south to Texas and Florida. They winter in the Gulf States, Mexico, and Central America.

The whippoorwill belongs to the family of "goat suckers" or *Caprimulgidae*. Scientific name, *Antrostomus vociferus*.

WHIRLPOOL. "The edge of the whirl was a broad belt of gleaming spray; but no particle of this slipped into the mouth of the terrific funnel, whose interior, as far as eye could fathom it, was a smooth, shining, and jet-black wall of water, inclined to the horizon at an angle of some 45 degrees, speeding dizzily round and round with a swaying and sweltering motion, and sending forth to the winds an appalling voice, half shriek, half roar, such as not even the mighty cataract of Niagara ever lifts up in its agony to Heaven."

It is thus that Edgar Allen Poe pictures the Maelstrom, that terrific whirlpool off the coast of Norway. The whirling motion is given to such an eddy or vortex of water by the meeting of two currents, by a current striking against a peculiarly formed bank, or by the activity of strongly opposed winds. In the case of the Maelstrom, the spinning motion is formed by tidal currents, which in stormy weather become so violent that they greatly endanger navigation. The onslaught of the torrent below Niagara Falls has worn a great circular basin out of the line of the river's course, thus forming that wilderness of howling spinning surge, the Niagara Whirlpool. These are probably the two most famous whirlpools in the world.

In ancient times it was believed that whirlpools were the openings into mammoth caverns of sea-monsters and mermaids. Fisher folk of Norway still think that a heavy object thrown into a whirlpool will cause it to close without harming their ship.

WHITEFISH. One of the finest and commercially most important of the fresh-water fish in America is the whitefish, a member of the salmon family. It is found in the clear lakes of North America, Europe, and Asia, often extending into Arctic regions, and everywhere is highly valued for food. It is generally of a bluish olive color above and silvery white on the sides and below. The common whitefish, which exists throughout the Great Lakes, reaches a length of two feet and weighs on an average four pounds, in rare cases reaching a size of twenty pounds.

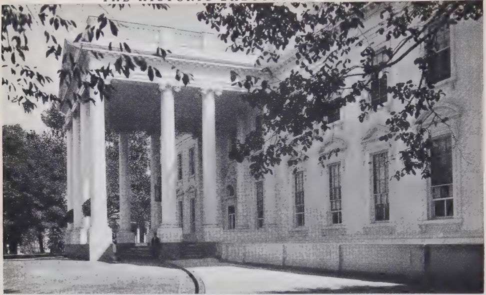
During the greater part of the year the whitefish remain in the deeper waters of the lakes, moving about in schools. Being toothless they feed only upon small animals, chiefly crustaceans. During the late fall the schools gather in shallow waters to spawn. Each female produces from 10,000 to 75,000 eggs, which sinking to the bottom, are mostly eaten by small fish. As fishing is prosecuted chiefly during the spawning season, when the fish are in shallows, the numbers have become so depleted that the United States and state commissions of fisheries find it necessary to propagate artificially hundreds of millions of eggs annually. Whitefish seldom take the hook, but are caught almost entirely by means of nets. (*See* Fish.)

The whitefish, which belongs to the genus *Coregonus*, is closely related to the cisco (genus *Argyrosomus*), sometimes called the "lake herring." This is a shorter fish with a larger mouth than the true whitefish. The cisco and whitefish are the most valuable fish of the Great Lakes.

WHITE HOUSE. The official residence of the president of the United States at Washington, D.C., though called the White House, was not originally intended to be a "white" house. It was built of a buff freestone, but after it was burned by the British in 1814, it was covered with a thick coat of white paint to obliterate the marks of the fire, and thus the name "White House" originated. It is frequently referred to by congressmen as "the other end of the Avenue" on account of its location on Pennsylvania Avenue, a mile and a half from the Capitol.

The building was designed by James Hoban, an Irishman, who modeled it after the viceregal palace in Dublin. But as the construction progressed, many features of the "great houses" of the Virginia plantations were added, for this was the sort of house with which four of the first five presidents were most familiar.

THE HISTORIC EXECUTIVE MANSION



The simple and unpretentious dignity of the White House is most befitting the residence of the republic's chief executive officer. It is merely a Southern colonial mansion on a slightly magnified scale.

The corner-stone was laid in 1792, and the building was first occupied in 1800, by President John Adams. Following the fire of 1814, the White House was rebuilt. It was subsequently added to from time to time, and in 1902 it was thoroughly remodeled in an attempt to bring it back to the original plan designed by Hoban.

The building is two stories high, 170 feet long, and 86 feet deep. The first floor contains the public rooms, including the famous East Room and Blue Room; while on the second floor are the private apartments of the president and his family. The offices of the president are now in a plain white office building of two stories at the south end of the White House, and just across the street from the War, State, and Navy building. Surrounding the White House are wide lawns and parks covering 75 acres, 20 of which are enclosed as private grounds.

WHITMAN, WALT (1819–1892). Whitman, who described himself as "the poet of democracy," was as typical an American as was Lincoln, upon whose death he wrote the poignant lament, 'O Captain! My Captain!' Born at West Hills, Long Island, he was descended from English and Dutch colonists who had emigrated to America before 1700. With the exception of one minister, his ancestors were all farmers, mechanics, and sea-faring men. With true American self-confidence and versatility, he began business life as an office boy, learned the printer's and carpenter's trades, taught school, reported for newspapers, and rose to the editorship of the *Brooklyn Eagle.*

At 35, having original things to say, and deciding that he could think best while engaged in manual labor, he supported himself by building homes for working people in Brooklyn. He was frequently seen sitting on bench or scaffolding, working on 'Leaves of Grass', a small volume of poems that was published in 1855. It attracted no attention until Emerson characterized the work as "the most extraordinary piece of wit and wisdom yet contributed to American literature." This started the now famous poems upon that career of eulogy and detraction that has lasted until the present day. By some they were challenged for their irregular form and unconventional ideas. They violated every classic tradition, and judged by the narrow standards of mid-Victorian times they were barbaric and sometimes highly improper. Written in what is known today as free verse, they had the primitive vigor of Beowulf. They had neither rhyme nor measure, but utilized rhythm with the finest artistry. Himself both a splendid animal and an idealist who believed nothing to be "common or unclean," nothing in human experience to be alien to poetry, Whitman glorified the life of the body with a frankness that left an anemic generation gasping. Accepting the challenge of his most violent critics, he declared that he would make his "barbaric yawp" heard across the roofs of the world.

Out of his experiences as a nurse in the Civil War, Whitman wrote 'Drum Taps', in which occurs 'My Captain!' in rhymed verse. After the war he was employed in one of the government departments at

Washington until 1873, when, partly disabled by a paralytic stroke, he retired to Camden, N.J. There for nearly 20 years he lived the free unworldly life of a poet. New poems appeared from his pen, and new editions of 'Leaves of Grass' were issued frequently. Everything he wrote expressed his own untrammeled Americanism, and his belief in equality, brotherhood, love, charity, faith, and candor. He never assumed any superiority by virtue of his own quality and gifts, but associated by choice with workingmen, and liked to mingle with common crowds on street-cars and ferry-boats. And in his writings he used no poetical expressions, figures, or ornaments, but spoke his plain thought simply and with the vigor of a free man who says freely all that he thinks. Yet the "good gray poet" never captivated the hearts of the masses of his countrymen whose tumultuous voice he aspired to be; instead—ironic fate!—his fame is greater and his work is better known in Europe than in America.

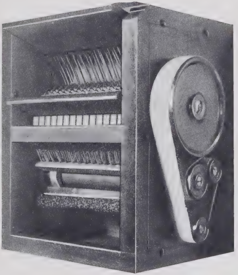
WHITNEY
Inventor of the Cotton Gin

Whitman's books of poems are: 'Leaves of Grass'; 'Specimen Days and Collect'; 'Selected Poems'; 'Drum Taps'; 'Goodbye My Fancy'; 'November Boughs'. His prose works are: 'Calamus'; 'The Wound Dressers'; and 'The Diary in Canada'. Outdoor scenes and thoughts from his works were selected by John Burroughs and published under the title of 'The Rolling Year'. A complete edition of his works with critical estimates and biographical notes was published in 1892.

WHITNEY, Eli (1765–1825). One fine morning in 1793 a young man was studying law in his room in a big plantation house on the Savannah River, in Georgia. A company of rich planters was being entertained by the mistress of the house, so the young man had withdrawn to his own quiet quarters. Presently he was interrupted by a black servant who said that his hostess and the gentlemen wished to see him in the drawing-room. He went immediately.

"Gentlemen," said his hostess, "this is my ingenious young friend, Mr. Whitney. Explain what you require, and I am sure he can help you."

MODEL OF THE FIRST COTTON GIN



In this machine of Whitney, the cotton-bolls were fed into the hopper above. From there they dropped down against that wire screen. The hooked teeth on the big revolving drum passed between the wires, seizing the bolls and dragging them through, but leaving the seeds behind. Revolving brushes below then brushed the combed-out cotton fiber from the drum teeth.

"Will you please invent for us," said one of the gentlemen, perhaps a little skeptically, "a machine for ginning cotton, and do it as soon as possible. The South has unlimited acres for cotton-growing, and the new inventions in England for spinning and weaving have increased the demand enormously. But there is little use in our growing the cotton so long as the fiber must be separated from the seed by hand."

The man to whom this request was addressed was Eli Whitney, then 28 years old. He was born in 1765, a month later than Robert Fulton. His birthplace was Westboro, Mass., and his ancestry Puritan. His home was a plain, bare farmhouse, and his father a stern unimaginative man who brought his children up to hard work and few pleasures. Every New England farmer at that time had a workshop, and Eli showed such skill in making and mending the many articles needed in house, stable, and field that the shop was practically turned over to him. One cold Sunday, when sickness kept him home from church, he had taken his father's silver watch apart and put it together again so well that no one knew it had been meddled with. He mended violins and made nails on a little forge during the Revolutionary War when the supply from abroad failed. Of course he went to school and learned to read and write and cipher. When he was 19 he set about earning enough money to go to Yale College; but it was a long hard task, and he was 27 when he graduated. He had then accepted the offer of a position as teacher in a private school in the South, and was using his spare time to study law.

Eli Whitney had never examined a cotton-boll when he was asked to invent the gin, but he got the idea at once that only *fingers* of some sort could do the work. A shop was fitted up for Whitney in the basement of the plantation house and he set to work. The gin which he invented consisted of a boxlike enclosure below an open hopper. Inside was a cylinder set with rows of sharp wire teeth, the whole turning with a crank. A slotted steel plate half enclosed the cylinder, the teeth slipping through the slots as a crank was turned. As the teeth extended beyond the slots, they caught the fibers and tore them from the seeds, the bolls dropping down from the hopper and the stripped seeds falling through a crevice below. Though it was a simple device of mechanics, involving no such principles as lay behind the steam engine, it had an immediate and tremendous effect on the South.

Whitney never profited by his invention financially. His machine was stolen and copied as soon as it was completed; his patent was infringed; the factory which he set up was burned; his business injured by greed and malice; and lawsuits consumed his earnings and dragged through the courts until the patent's limit of 14 years had expired. His claim to the honor of the invention was finally established, and with that he had to content himself.

At the age of 40 Eli Whitney was penniless but not defeated. He had fame, business ability, rare mechanical genius, and a clean name as assets. At that time no firearms were made in the United States so good as those of England, and it was practically certain that the United States would be compelled to fight another war with Great Britain for protection of her merchant marine. Eli Whitney could be trusted to make good and honest guns. So he built a factory for making firearms near New Haven, Conn., and Whitneyville grew up around it. He had to design all the parts of his improved gun, invent many of the machines used, and train workmen into skilled artisans. His boyhood motto had been: "Whatever is worth doing is worth doing well." This principle he put into practice in making his guns. In his factory he introduced the new principle of the division of labor that was making the factories of England so effective.

This great inventor prospered, but he never became so rich as he might have been. Better than money he loved his family and friends, beautiful things, and the society of refined and cultivated people. His sister was his dearest friend; his brother a partner in business; he was never too busy to play the devoted lover to his wife or to contrive ingenious toys for his children. His long, fruitless toil to secure his rights in the cotton gin, and the dishonesty, envy, and greed that had pursued him for a dozen years left no bitterness behind to poison his life. He died on Jan. 8, 1825, and was buried in New Haven.

WHITNEY, MOUNT. The loftiest summit in the United States outside of Alaska is Mount Whitney, a peak of the Sierra Nevada Range in southeastern California. It towers 14,502 feet above sea-level, and its precipitous eastern slope rises nearly 11,000 feet above Owens Valley. A most interesting fact is that Death Valley, the lowest depression on the continent, lies less than 100 miles from this giant mountain. As you climb you will notice that the sides of the mountain are scored and polished here and there by the ancient glaciers, that flowed down to the present valleys of the Kern and Owens rivers as tributaries to greater ice flows. Today, however, the mountain has no glaciers, only small and shallow patches of lasting snow and ice on the northern slopes. Mount Whitney was named in honor of an American geologist, Josiah Dwight Whitney, of Harvard University. It has been ascended several times.

WHITTIER, JOHN GREENLEAF (1807–1892). One has only to read Whittier's 'Barefoot Boy' to picture for himself the happy, healthy, but hard-working childhood of "the Quaker Poet" on the small farm at Haverhill, Mass., where he was born. And in his long descriptive poem 'Snowbound' he gave a charming account of the quiet home joys, outdoor sports, and the hardships, sturdily overcome or cheerfully endured, of a bleak winter in the valley of the Merrimack. Everyone on the stony hill farms of that region could by industry and economy be sure of the plain comforts of living, but there was never much money. So Whittier, a good and thoughtful boy, who wanted to do and say helpful things for a larger world when he grew up, taught country schools and cobbled the neighbors' shoes to earn enough to pay for two years' instruction in Haverhill Academy.

A copy of Burns' poems loaned him by his teacher when Whittier was 15 awoke in him a desire to write verse. His first published poem, written at the age of 19, appeared in a periodical edited by William Lloyd Garrison. It led to a lifelong friendship with this bold and gifted leader of the anti-slavery movement. To this unpopular cause Whittier devoted his own talents and became its recognized poet, as early as 1832. Nor should it be forgotten that Whittier's letters show that he helped every good cause by his shrewd political advice, for this New England Quaker, had he not chosen to stand with the anti-slavery group, might have had a place in Congress with his distant relative Daniel Webster. While engaged in newspaper work in Boston, Hartford, and Philadelphia he wrote anti-slavery tracts and pamphlets, and in verse of quiet strength and wide influence he celebrated or deplored the chief dramatic events of that political conflict. He was not to be silenced, for when the printing office of *The Pennsylvania Freeman* was destroyed by a mob, his reply to violence was the publication of his 'Voices of Freedom'.

Whittier contributed some fine patriotic poems to the cause of Union during the Civil War and when the war was won he wrote his 'Laus Deo' (Praise God). Amesbury, near Haverhill, was his home after 1836 and his house there became one of the literary shrines of America. There he wrote hymns that are sung in the churches of several denominations. In narrative poems and ballads he preserved the romantic legends and stirring history of the seaboard colonies and he described the rural scenes and social life of the New England of his boyhood days as no other American poet has done.

Whittier's verse is characterized by extreme simplicity of thought and style, and by what Lowell calls a "genial piety." It is unequal in merit, sometimes faulty in rhyme, and he has a tendency to moralize. But as one sympathetic critic has said, "this perfectly expresses the poet himself, his character, and point of view." First of all a reformer, Whittier used poetry as consciously and candidly for moral ends as a preacher uses the sermon. And as clearly as though from the pulpit, he preached the beauty of holiness, the pure joys of home life, the duty of laboring for humanity and justice, the glory of sacrificial patriotism, and the consolation of faith. His poetic gift was more limited, but not inferior in quality or in influence over his day, to Longfellow's.

Whittier's chief poems, in the order of publication, are: 'Legends of New England'; 'Ballads'; 'Voices of Freedom'; 'In War Time'; 'National Lyrics'; 'Home Ballads'; 'Snowbound'; 'The Tent on the Beach'; 'Among the Hills'; 'Ballads of New England'. His favorite short poems are: 'The Barefoot Boy'; 'Barbara Frietchie'; 'Maud Muller'; and 'In Schooldays'.

WILLARD, FRANCES ELIZABETH (1839–1898). This gentle Christian reformer and practical philanthropist is one of the best loved and most widely celebrated of all American women. To her devotion and trained ability is due the phenomenal growth of the Woman's Christian Temperance Union and very largely of the prohibition movement. Born at Churchville, near Rochester, N.Y., on Sept. 28, 1839, she was fortunate in having parents of rare moral and intellectual character. To give their older children educational advantages, they removed to the college town of Oberlin, Ohio. When Frances was seven they settled on a farm near Janesville, Wis. At 17 Frances was sent to Milwaukee to school and afterward to the Woman's College at Evanston, near Chicago. For the next 40 years this was her home. She became dean of her own alma mater, resigning in 1874 when the college was incorporated with Northwestern University.

Turning from the most attractive financial offers, she entered the temperance movement, joining a little band of women without money or experience in Chicago. Her decision was talked about, for she was a noted woman of proved leadership in the educational world. To the W.C.T.U. she gave immediate impetus by the conversion of hundreds of men from drunkards to useful citizens. She consented to accept a salary sufficient to provide for her mother and herself and, finally, the modest gift of Rest Cottage, the home in Evanston, but her earnings as lecturer and writer she turned into the W.C.T.U. fund. In 1879 Miss Willard was elected president of the national W.C.T.U.—an office she filled for 20 years. She insisted upon the adoption of a demand for woman suffrage by the organization, on the ground that the ballot was the most effectual weapon to defend the home, and she made her organization a unit when it used its influence for prohibition.

After 1880 Miss Willard was almost continually engaged in travel and in organizing states and foreign countries, and at the time of her death 35 nations had lined up under the white ribbon. In addition to this work she wrote books, established and helped edit *The Union Signal*, inspired the Chicago organization to build the Woman's Temple at a cost of $1,000,000, to establish the W.C.T.U. home for working women, a publication office, and national headquarters. All of this grew in 25 years from a beginning so small that at first Miss Willard could not always get money for carfare and lunches, while the national W.C.T.U. had a total income of only $1,200.

A scholarly, refined, reserved woman, Miss Willard was aggressive only in act, never in manner. A statue of her has been placed in Statuary Hall, in the Capitol at Washington, among those of presidents, statesmen, and military heroes.

The FIRST *and the* LAST *of* GERMANY'S KAISERS

How William I and His Great Minister Bismarck Created the German Empire, and How His Grandson William II, in His Craving for More Power, Plunged the World into War and Lost His Throne

WILLIAM, GERMAN EMPERORS. Two kings of Prussia of this name, members of the house of Hohenzollern, have also borne the title "German Emperor" as heads of the modern German Empire.

WILLIAM I (1797–1888), the first German emperor, was born when his country was a cipher in European politics, and spent his youth in the days when Napoleon had overrun Prussia and all Europe. It was these disasters that contributed much to the early death of his mother, the beautiful Queen Louise, in 1810. As second son he was not expected to come to the throne and devoted himself entirely to the army. In the democratic revolutionary year of 1848 he was obliged to leave Berlin, where he was unpopular as "Prince Cartridge." The next year he commanded the Prussian troops that defeated the revolutionary army under Franz Sigel, and drove Sigel and Carl Schurz as refugees to America.

His elder brother, King Frederick William IV, was childless, and in his later years insane. As regent and then as king of Prussia (after 1861) William I bent every energy to the reform and building of the Prussian army. It was his one significant independent act. It brought him into conflict with the Prussian legislature and forced him to call Bismarck as minister-president. After 1862 the history of William's reign is the history of his support of Bismarck's measures and policies—reluctantly at first but in the end unwaveringly.

He personally preferred to remain simply king of Prussia, but Bismarck and the Crown Prince persuaded him to accept the title of German Emperor in 1871.

Confidence in his simple, direct, and generally upright character was an asset to the new empire and also to the more unscrupulous Bismarck. As the "Old Emperor" he lived on to the age of 91. His bumptious grandson William II, in an effort to belittle Bismarck's work and attribute all credit to the Hohenzollerns, always called him "William the Great" and erected innumerable statues to his memory.

WILLIAM II
Last Emperor of Germany

William II (born 1859) came to the throne after the brief reign of his father, Frederick III (March to June 1888).

Since the days of the great Napoleon no ruler has been so exalted to the skies or suffered so terrible a downfall as this third and last German emperor. Indeed the downfall of the Kaiser was greater in one way than that of Napoleon, for the latter had learned by early experience the uncertainty of fate, while the Kaiser believed himself to be sovereign by the grace of God to rule Germany, and to carry "Kultur" to the farthest corners of the earth.

The son of the popular Crown Prince Frederick and of the eldest daughter of Queen Victoria of England, he showed toward both parents anything but the love and respect due from a son. As a young man of 29—well educated in all the arts, versatile, and self-confident to an extraordinary degree—William II had come to the throne (June 1888) with the determination to rule as well as reign. So one of his earliest acts as emperor and Prussian king was to drop overboard the old pilot Bismarck, who had made the German Empire and had guided its destinies during the reign of his grandfather, William I, and the hundred days of his father's death-bed rule.

From birth William II's left arm was shriveled and deformed, yet he constantly displayed a feverish energy of action as well as of mind—engaging in spectacular visits to other lands, deer and wild-boar hunts, army maneuvers, and the like. He prided himself on being scientist, dramatist, painter, and theologian, and never hesitated to set his opinion against that of specialists in these lines. He was immensely proud of his painting 'The Yellow Peril', showing a vast Asiatic dragon creeping in upon European civilization.

From the first William placed his reliance on his army. Amid the constructive work of statesmen, financiers, and captains of industry—which raised Germany almost at a bound from the position of one of the backward countries of Europe to one of the most progressive—was to be heard in crisis after crisis of European affairs the ominous saber-rattling of this Prussian "War Lord." "It is the soldier and the army," he once declared, "and not the majorities and parliamentary decisions, that have forged the German Empire. It is on the army that my confidence rests."

But to win for Germany the "place in the sun" that he claimed, he first needed a navy as well as an army. With the declaration that "Germany's future is upon the waters," he turned with characteristic energy, after 1898, to the development of the German fleet. In spite of his protestations of friendship, England viewed this action with alarm, for the island character of that country makes command of the sea a necessity to her. That alarm was at last seen to be justified when his policies reached their full fruition in 1914 and plunged the world into war. Like a gambler he had staked all upon war, and he lost—ruining himself and his people in the venture.

Finally on Nov. 9, 1918, when Germany itself had risen in revolution against him, William II sought safety in flight into neutral Holland. There he abdicated his double crowns of Prussia and the German Empire. The Allies sought to put him on trial but Holland refused under existing international law to give him up.

A cartoon published by the German journal *Simplicissimus* fittingly characterized the close of his reign. It showed a desolate "No-Man's-Land" stretching away under gray skies to a remote horizon. In the far distance was the departing figure of William II seeking refuge in Holland. In the foreground stood a tragic group of widows, orphans, and war cripples; and underneath were these biting words: "We shed no tears for him, for he has left us no tears to shed."

Henceforward the ex-Kaiser lived a life of seclusion, first at Amerongen and later at Doorn, near Utrecht. The Kaiserin Augusta Victoria died in 1921, and the following year he married Princess Hermine of Preuss. Although various movements were set on foot for his restoration to the throne, he always disavowed any connection with them.

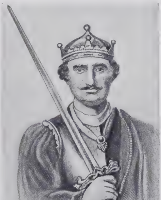
Following the revolution in Russia in 1917 there was published a series of remarkable letters from the Kaiser to Czar Nicholas II—signed "Willy" and addressed to "Nicky"— in which was first fully revealed the character of William II's intrigues for some years before the war. Other revelations from German archives at Potsdam (near Berlin) showed how the Kaiser backed up Austria in the demands which brought on the World War. "Serbia," wrote he, "is a pack of brigands who must be brought to book for their crimes." When England first let it be known that she would not stand aside and let France be crushed, the Kaiser in his fury wrote of Lord Grey, the British foreign minister: "Low hound! Responsibility for peace rests upon England alone and no longer upon us." But William II in those momentous later years was far more a tool in the hands of the powerful military and naval cliques of Germany than the real ruler of her destinies.

The Four WILLIAMS *of* ENGLAND

The Duke of Normandy who Conquered the Island and Knit It Together by His Stern but Just Rule—The Hated King Rufus—The Able William of Orange, and the Bluff Old Sailor King, William IV

WILLIAM, KINGS OF ENGLAND. Only four kings of England have borne this name, which was introduced with the Norman Conquest.

WILLIAM I, THE CONQUEROR, who ruled England from 1066 to 1087, was the sixth Duke of Normandy in descent from Rolf, or Rollo, the founder, and had many qualities of his Viking ancestor. He was only seven years of age when he inherited the duchy, under the guidance of faithful and able guardians, and was forced to struggle against his rebellious barons. At 24 he had not only established his authority, but had made himself the mightiest lord in France by other conquests.



WILLIAM I
Norman Conqueror of England

But William's ambitions went further. Across the Channel reigned his father's cousin, the childless Edward the Confessor, to whom William paid a visit and apparently obtained that king's promise that he should succeed to the throne of England. So when Edward died in 1066 William claimed the throne, despite the fact that Earl Harold was chosen king by the English. He had other pretexts to strengthen his claims. He had extorted an oath from Harold to support his succession when Harold was shipwrecked on the coast of Normandy; he had married Matilda, a Flemish princess descended from the old Anglo-Saxon line of kings; and he had obtained the blessing of the pope upon his enterprise.

Landing with an army of Norman adventurers and soldiers of fortune from all over Europe, William defeated the forces of the English king in the battle of Hastings (1066), leaving his hapless rival dead on the field. Tradition has preserved a characteristic anecdote. As William landed he is said to have stumbled and fallen on the beach—an unlucky omen. With ready wit he clutched a handful of sand and holding it aloft said: "By the splendor of God, I have taken possession of England!"

After Hastings the men of London went out to meet the conqueror and hailed him as king. He was crowned on Christmas Day, and became the founder of a new line of English kings. The blood of this Norman conqueror flows in the veins of every king and queen who has sat on the throne of England since his day.

Five years of warfare were needed to subdue the turbulent earls of the north and west. King William showed himself a stern and pitiless master, carrying waste and ruin into wide areas and erecting castles to keep the people in subjection. He seized the lands of those who had fought against him and gave them to his followers, or allowed their holders to take them back only on payment of heavy fines. He thus established the feudal principle that every foot of the soil was the property of the Crown, and granted it to his vassals only on condition of an oath of fealty and the promise to serve him with money and men. William further strengthened the power of the Crown against the great lords by demanding an oath of allegiance from all freemen, which took precedence of the fealty they owed their lords.

His wise policy of retaining the old Anglo-Saxon laws, courts, and customs, with only a few innovations, confirmed the loyalty of the mass of the people. Thus the principle of local self-government, which lies at the root of the political system of the English-speaking peoples, was preserved and strengthened. At the same time William taught his people of England the advantages of a strong central government, powerful enough to control the feudal lords and secure justice for all.

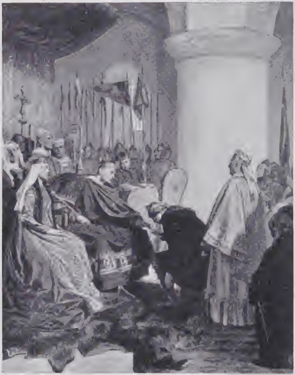
Among the new measures instituted by the conqueror were the reservation of great tracts of forest for the king's hunting, and the compilation of a great census known as the Domesday Book. "So very narrowly did he cause the survey to be made," complains the old Anglo-Saxon chronicle, "that there was not a single rood of land, nor an ox, or a cow, or a pig passed by, and that was not set down in the accounts."

William met his death in 1087, from an internal injury received while warring with Philip of France. He was a man of great stature and weight, with a tremendous voice. The old chronicler tells us that he was "mild to those good men who loved God, but severe beyond measure to those who withstood his will." Though he was despotic and grasping, he was "a very wise and great man." Such was the good order he established that, according to the quaint old historian of his time, "any man, who was himself aught, might travel over the kingdom with a bosom of gold unmolested, and no man durst kill another, however great the injury he might have received from him."

Before his death William divided his lands, giving Normandy to his eldest son Robert, and England to William Rufus, his next son. To his youngest son

Henry he left 5,000 pounds of silver, saying—so the story goes—that in due time Henry would get all that his father had. (*See* Feudal System; Harold; Hastings, Battle of; Normandy.)

THE GRANT OF LONDON'S CHARTER



"William the Bishop and Gosfrith the Portreeve" receive the new London charter from the Conqueror. The charter was granted soon after the battle of Hastings and the acceptance of William's rule by the people of the city. At King William's right sits his wife, the Flemish princess Matilda. This picture by J. Seymour Lucas is in the Royal Exchange of London.

William II, who was called Rufus or "Red," ruled from 1087 to 1100. "He was hated by almost all his people," says the old chronicler, "and abhorred by God." He "openly mocked at God and the saints" and "He every morning got up a worse man than he lay down and every evening lay down a worse man than he got up." With fair promises he prevailed on the people to help him put down the Norman lords, who sought to put his elder brother Robert on the throne, and after gaining the victory with their aid, he turned on his subjects and oppressed them grievously. He was capricious, ungrateful, extortionate, wasteful, and vicious. The only good thing that can be said for him is that he kept down the barons with a strong hand and rigidly enforced peace in the land.

He called down the wrath of the monks in particular because of his shameless practice of selling church offices or keeping them unoccupied that he might seize their revenue for himself. Once when he fell sick and thought that he was dying, William vowed to turn from his vile ways and to fill the archbishopric of Canterbury, which he had kept vacant for four years. His choice fell on Anselm, abbot of Bec in Normandy, the greatest theologian of the age. A gentle and upright man, so tender that he is said to have saved the life of a hunted hare, Anselm accepted this high office with the greatest reluctance, protesting that it was like "seeking to yoke a young unbroken bull to a weak old sheep." His forebodings proved only too true, for when William recovered he returned to his old ways. Contrary to church rules he insisted upon conferring the symbols of office upon the archbishop himself, instead of allowing it to be done by the pope. On this question of lay investiture of the clergy, as the consecration of priests by civil rulers is called, Anselm took a determined stand against the king, and there was a never-ending series of disputes until four years later when, wearied of wrangling, he went to Rome and William again seized the property of the archbishopric.

In 1096 William received Normandy as a pledge from his elder brother Robert, who mortgaged his duchy for funds to join the First Crusade. War against the Scotch, the Welsh, and rebellious barons checkered his reign. He came to a fitting end, slain by an arrow in his own New Forest which his father had set aside for his favorite sport of hunting. Whether the shooting was by accident or intention no one knows. No one cared enough for him to do his body honor, and he was hastily buried without religious rites at Winchester. He was succeeded by his younger brother as Henry I.

William III, who ruled England from 1689 to 1702, came to the throne by the revolution of 1688 which cast out James II. He was the great-grandson of William the Silent, Prince of Orange, who had won for the Dutch Netherlands their independence from Spain, and since 1672 he himself was "stadholder" and captain-general of the United Provinces. But he was also the son of one English princess, daughter of Charles I, and the husband of another, Mary the eldest daughter of King James II.

Since William was the chief defender of the Protestant interests on the Continent, and Mary was regarded by most as the real heir to the English kingdom, what was more natural than that English nobles and bishops should turn to him, with an invitation to save them from the tyranny and attempted Catholic restoration of James II? He had but to land (Nov. 5, 1688) with an expedition of 14,000 men, and almost the whole of England and Scotland rallied to his support. James II conveniently ran away, and William and Mary were crowned joint sovereigns. A Bill of Rights passed by Parliament ratified the changes. Ireland, however, did not submit until James was defeated in the battle of the Boyne; and throughout his reign plots were hatched against his life and rule by followers of the exiled Stuarts. Although William was never popular with his English subjects on account of the fact that he was a foreigner and lacked geniality, his reign was one of great progress in real liberty and constitutional government, and he ranks in the judgment of historians as one of the ablest of Britain's kings.

William's chief interest, however, was always on the Continent. He had come to power in the Netherlands at a time when Louis XIV was embarking on his plans for "universal monarchy," and he had already (1672–78) won fame for his skill in generalship and in building up alliances to resist French aggression. He chiefly valued the English crown for the added resources it brought him in this life-long duel. Twenty times William barely escaped being crushed. But he "represented the ideas of the future—free thought in religion, popular sovereignty in politics," and these principles sustained and inspired him. After another eight years of war (1689–97), Louis XIV made a peace at Ryswick (1697) which left him only slight gains, and bound him to cease his support of the Stuart pretender to the English throne. The "peace", however, proved to be but a breathing space.

Five years later, as the last and greatest of the wars with Louis XIV was about to break out, William III died from the effects of a chill and a fall from a horse. Queen Mary had died several years before. Since they had no children the throne passed to her sister, the Princess Anne (*see* Anne, Queen of England; Bill of Rights; Marlborough, First Duke of).

William IV, the "Sailor Prince"

WILLIAM IV, who reigned for only seven years (1830–1837), was known before his accession as the Duke of Clarence. He was the third son of George III, and was born in 1765. He was a sailor prince, having been sent to sea at the age of 14. A Spanish admiral, seeing him doing duty as a midshipman, exclaimed: "Well does Great Britain merit the empire of the sea, when the humblest stations in her navy are supported by princes of the blood!"

William was in his 65th year when he became king. He was bluff and hearty in manner, as became a sailor, and was liberal in his politics. The greatest measure of his reign was the Parliamentary Reform Act of 1832. This opened the way to a flood of other liberal measures, which continued to follow one another through Parliament long after William IV had passed from the scene and his niece Victoria had come to the English throne. (*See* Parliament; Russell, John.)

WILLIAM THE SILENT, PRINCE OF ORANGE (1533–1584). When Charles V with impressive ceremonies laid down his office as ruler of Spain and the Netherlands (1555), he leaned on the arm of a tall young man, William, Prince of Orange. On the other side of him stood his sickly ill-shapen son, Philip II, who was taking over the duties his father was laying down. In a few years these two young men were to be bitter enemies, and William of Orange was to be the leader of the Dutch armies in their struggles for religious and political liberty (*see* Philip, Kings of Spain).

At the time of Charles' abdication William was 22 years old. At the age of 11 he had succeeded to the little principality of Orange in southern France and to possessions in the Netherlands. From early youth he had been brought up at the court of the emperor, who had given him many important duties and sent him on diplomatic missions. Thus he gained the experience and wisdom which made him the greatest statesman of his day.

On one mission to France, William won his name "the Silent" from the good sense with which he held his tongue when the king of France incautiously spoke to him of Spain's plan for rooting Protestantism out of the Netherlands. "From that hour," wrote William 20 years later, "I resolved with my whole soul to do my best to drive this Spanish vermin out of the land."

And for this reason when the bloody persecutions of Philip's general, the Duke of Alva, drove the Dutch to armed revolt, William put himself at the head of the movement. By birth a Lutheran German, brought up as a Catholic, he accepted finally the Protestant faith of his Dutch compatriots. But his varied experience taught him the necessity and wisdom of religious tolerance on the part of a ruler. He was thus ahead of his time and in sharp contrast with the bigoted Philip II.

At first the struggle was a losing fight. William was defeated and was obliged for a time to take refuge in Germany. Misfortune dogged his footsteps but he did not despair. "With God's help," he wrote, "I am determined to go on!" And go on he did until finally, in 1581, the seven northern provinces of the Netherlands issued a formal declaration of independence, just as the 13 American colonies did almost 200 years later. Holland was now a separate nation under the leadership of William of Orange, who was the "father of his country," just as George Washington was of his. William now settled at Delft and, with the remnants of his former wealth, supported himself in a simple unostentatious style.

Meanwhile King Philip had taken the despicable step of putting a price on William's head. In 1584 an assassin, animated by religious fanaticism and by the hope of reward for his family, shot and mortally wounded the heroic leader. Unlike Washington, William did not live to enjoy the fruits of the struggle to which he had given his life, but his place as the creator of a nation is just as firmly fixed.

WILLIAMS, Roger (about 1604–1684). A wanderer and exile for conscience's sake, Roger Williams was forced to found a city and a state of his own before he could worship God in his own way. While a student at Cambridge University, England, this young Welshman had become bitterly opposed to the ceremonies of the Episcopal church. His religious convictions prevented his preaching in England, and so in 1631 he landed in Puritan Boston. Here he was well received and was offered charge of the church of the little colony, but he refused the position because the congregation had not formally announced its separation from the Church of England. Williams decided that Plymouth Colony, which had a "separatist" church, would be a more congenial atmosphere, and so went there to live. He earned his living at labor and trade and sometimes assisted in the church services. Governor Bradford pronounced him a man of "many precious parts, but very unsettled in judgment."

Soon he became, according to the worthy governor, even more unsettled. He criticized the Plymouth government for some of its acts, and moved on to the more radical town of Salem. There he taught that King James I of England had told "a solemn public lie" when he gave to the colony a grant of land, because the land belonged not to the king but to the Indians.

Although the laws of the colony required attendance at the Puritan church, Williams declared that no government had a right to compel a man to go to church. If he had merely held these opinions quietly, he would probably not have been molested; but Williams was lacking in tact and stirred up so much trouble that finally, in 1635, the authorities ordered him to leave the Massachusetts Colony. Because of illness, however, they offered to allow him to remain until spring if he would keep still. This Williams absolutely refused to do, and to avoid being sent back to England immediately he escaped to the Indians, with whom he remained during the winter.

In the spring of 1636 he began a little settlement to which he gave the name of Providence, and this began the colony of Rhode Island. Williams bought his land from the Indians, with whom his influence was greater than was that of any of the other colonial leaders except William Penn; and he was able on two occasions to protect from attack the people of Massachusetts who had driven him from their midst. In Providence he established what has been considered the first Baptist church in America. To protect his colony from the attacks of the New Englanders, however, he went to England in 1643 and obtained a charter from King Charles I. Under this charter he served as member of the general assembly at various times, and as governor of the colony from 1654 to 1657.

Rhode Island was founded on Williams' idea of complete freedom for the individual in matters of religion. It was the first colony to take this stand. Because of this attitude Rhode Island was long regarded by the other colonies as a "crank's paradise" and "New England's dumping ground for the disorderly and eccentric elements of her population."

WILL-O'-THE-WISP. A little after sunset you may sometimes see a pale bluish ghostly light floating about two feet over marshy places and stagnant pools. Varying in size and shape, it sometimes shines steadily until morning; while at other times, like a nervous goblin, it disappears and reappears at about half-hour intervals. Sometimes it is stationary, and sometimes it flits about in the darkness, or travels with great rapidity.

This strange luminous appearance is variously known as Will-o'-the-wisp, Jack-o'-lantern, Spunkie, and *ignis fatuus* (Latin for "vain fire"). Country folk used to believe it the work of evil spirits bent on luring them to destruction. Even to-day, notably among the fishermen and coasting seamen of southern Europe, some of the old superstitions survive.

The cause of the glow is generally supposed to be the slow combustion of some gas or gaseous mixture produced from decaying vegetable matter in marshy places. It is not a common sight, and many scientists who desired to investigate it have never succeeded in finding it. It is most frequently seen in the north of Germany, the south and northwest of England, and the lowlands of Scotland.

WILLOW. Someone has said that the willow is "a fitting genus to go forth and inhabit the earth, for it is tolerant of all soils and asks only water." The species of willows range from tiny plants an inch or two high to lofty trees, and the distribution is from the cold arctic regions and high mountain-tops to the subtropics and even the tropics of the three great continents. We eagerly welcome the furry little catkins of the willow as harbingers of spring. Its graceful beauty we acknowledge by planting it extensively as an ornamental and shade tree; while the many uses to which we put its wood and bark give it a high rank among useful trees.

Botanists differ as to the number of species of willow. Cross-fertilization between the species does much to increase this difficulty. There are at least a hundred, and possibly 160 varieties, much alike in every respect but size and habit of growth.

All willows take root readily and grow with great rapidity. They have many and large roots, remarkable for their toughness and tenacity of life. The trees are often planted on the borders of streams in order that their roots may protect the banks against the currents. The bark is furrowed and scaly.

In North America there are about 60 species of willow. One of the largest and best known native species is the black willow—so called from its blackish bark—a tree 20 to 40 feet high. It is usually found leaning over the water of streams and lakes, and is common from New Brunswick to Florida and westward to the foothills of the Rocky Mountains and in California. Its narrow graceful yellow-green leaves usually curve to a sickle shape. The glaucous willow, or pussy willow, another native variety, usually grows as a shrub. It is found along the banks of streams from Nova Scotia to Manitoba and throughout the eastern and middle western states.

The magnificent tall white willow, found in cultivated ground, is probably a descendant of the white willow of Europe, which was early introduced into the United States and has become generally naturalized. It has no equal among the native American willow trees. With the crack willow it furnishes the most valuable wood of the genus. The latter is a beautiful tree sometimes 100 feet high with a full round head. Its leaves, clear green and shining on top and whitish underneath, make a most attractive picture as they flutter in the breeze.

THE HARDY PIONEER, BLACK WILLOW

The Black Willow, not content to multiply by seeds and roots, founds new willow colonies by means of its brittle twigs, especially when it grows by the water.

The weeping willow came originally from China, where it is a favorite tree, and though it is of practically no economic value, is much cultivated throughout Europe and the United States for its beauty.

The wood of the willows is white, soft, and light, and is more durable in water than any other common timber. It is used for poles, baseball and cricket bats, farm tools, etc., and makes a fine charcoal. Paper is made from the wood pulp of the white willow. An important industry has developed from the use of the young shoots, or osiers, of certain varieties in basket-making and wicker work. The bark is used in tanning and is the source of the medicinal extract "salicin," used for rheumatism. Willow lumbering is a big industry along the lower Mississippi.

Scientific name of black willow, *Salix nigra*. Bark, dark brown or blackish, divided into broad flat ridges. Wood, light brown; sapwood, white; soft, close-grained, weak. Leaves, alternate lanceolate, 3 to 6 inches long, rounding at base. Catkins 1 to 3 inches long, borne on short branches and appearing before the leaves. Fruit, capsule cone-shaped, smooth, reddish brown. Seed, minute, surrounded by a tuft of long white hairs.

WILMINGTON, DEL. The American nation owes much to the manufactures of Wilmington, at the junction of the Brandywine and Delaware rivers. The famous brig *Nancy*, chartered in 1775 by Robert Morris to bring munitions from the West Indies, was built in the city. The first iron steamship and the first iron sailing vessel (1854) were built here. The Brandywine mills (in Brandywine village, across the river from Wilmington) furnished flour and meal to the patriot troops during the Revolution. Powder for all American wars since 1802 has been furnished by the Du Pont Powder Mills, founded by Jefferson's friend, E. I. du Pont de Nemours, who had learned the art of powder-making under Lavoisier, the great chemist and superintendent of the French government powder works. During the World War of 1914–18 the Du Pont company made about 40 per cent of all the explosives used by the Allied armies. Besides explosives, the company manufactures a great number of subsidiary products, such as chemicals, dyes, paints, ivory and leather substitutes, artificial silk, synthetic camphor, etc. Shipbuilding remains an important industry of the city, together with the manufacture of leather, railway cars, vulcanized fiber, foundry and machine-shop products, and paper and wood pulp.

The city is the most important manufacturing center as well as the largest city in Delaware. Its industrial prominence is due largely to its great natural advantages: the 126-foot falls of the Brandywine four miles from its mouth, the deep harbor for docking and building ships, and its nearness to the great coal and iron fields of Pennsylvania, Maryland, West Virginia, and Virginia.

Holy Trinity (Old Swedes) Church, dating from 1698, is the most notable relic of Wilmington's colonial past, though some of the old hip-roofed houses are said to date back to the period of Swedish rule. After coming under William Penn's rule the town received many Quaker settlers, and still has its Quaker element, influential even in a large population of Italians, Poles, and Irish. Population, about 112,000.

AMERICA'S PRESIDENT *in the* WORLD WAR

How Wilson Achieved Fame as an Educator—How the Governorship of New Jersey Led to the White House—His Two Terms in Office—The Tremendous Problems which Confronted Him and How He Met Them

WILSON, WOODROW (1856–1924). Thomas Woodrow Wilson—he early dropped the Thomas—came of a Scotch family of Presbyterian preachers and teachers, and the early impressions which he received in his father's home, amid the ministerial and college circles of Georgia and South Carolina, gave a stamp to the young man's mind and character which they were never to lose. It was a distinguished family circle, which drew to it many of the eminent Presbyterian leaders of the South during and after the Civil War. And all of its members were closer to Europe, especially England, than most Americans of the time, for British periodicals and British statesmen were studied and Gladstone was a hero of the family. At the time of his son's birth (Dec. 28, 1856), the father, Rev. Joseph Ruggles Wilson, was pastor of the Presbyterian church at Staunton, Va.; but within two years he accepted a pastorate at Augusta, Ga., where his family remained until his removal to Columbia, S. C., to become professor of theology in the Southern Presbyterian Seminary there. The boy was named after his mother's father, Dr. Thomas Woodrow, who had emigrated from England and became pastor of a Presbyterian church in Columbus, Ohio.

After a year at Davidson College, in North Carolina, Woodrow Wilson, in 1875, went to Princeton, where his father had studied theology. At Princeton young Wilson busied himself much more with books of general literature and with the conduct of politics, both American and English, than some of his teachers liked. This bent toward public life was made still more evident when he published a remarkable article, a year before he graduated, on the subject of responsible government. The point of the study was that congressional government, as practiced in the United States, divides responsibility and thus lends itself to inefficiency and corruption. With his mind still drawn toward public life as a vocation, Wilson, after graduation at Princeton in 1879, studied law at the University of Virginia.

His Teaching Career Begins

Two years later, armed with his law diploma, he settled in Atlanta, Ga., where he entered into a partnership and undertook to make his way in the pushing commercial world. In the autumn of 1883 he was again at his books and a member of the graduate classes of Prof. Herbert B. Adams, a famous teacher of history in Johns Hopkins University, Baltimore. He completed the studies for the degree of doctor of philosophy, and shortly afterward published a book entitled 'Congressional Government', a study of American methods of government that attracted immediate attention. After teaching history and political science at Bryn Mawr and Wesleyan universities, in 1890 he was made professor of jurisprudence and economics at Princeton, where he quickly took rank among the foremost teachers in the country.

In 1902 Professor Wilson was elected president of Princeton University. From that time he was one of the educational leaders of the United States and a champion of essential reforms. His immediate work was the re-making of Princeton so as to deepen and broaden its educational work and democratize and stimulate student life. This led to resistance and opposition on the part of some members of the faculty, students, and alumni; and when a sum of several million dollars was offered the university on condition that its expenditure should be controlled by his chief opponents in the faculty, President Wilson was ready to resign.

Becomes Governor of New Jersey

Meanwhile, the president of Princeton had become an influential national character. In 1906 Col. George Harvey, editor of *Harper's Weekly*, called Mr. Wilson a fit candidate for the presidency of the United States, and in his paper kept Wilson's name before the country. In 1910 Wilson was nominated and elected governor of New Jersey under circumstances that made him the outstanding progressive of the Democratic party. During the year 1911 he was supported by a majority of the state legislature, and set the state upon a new and higher social and political level. Then in 1912 the Republicans regained control of the legislature; authority in government was divided, and the result was, as he had predicted in his early essay on government, no government at all.

Governor Wilson was now an avowed candidate for the democratic nomination for the presidency in 1912. But his record as governor had alienated Colonel Harvey and certain distinguished persons enlisted on his behalf by the editor of *Harper's Weekly*. Other support was found in the progressive elements of the Democratic party. The Republican convention at Chicago, early in June, re-nominated President Taft; but the followers of ex-President Roosevelt so resented the "steam roller" methods by which the reactionaries controlled the convention that they withdrew and in August formed the Progressive ("Bull Moose") party, with Roosevelt as their candidate (*see* Roosevelt; Taft).

In the Democratic convention at Baltimore, in late June and July, there was a long and bitter struggle between the progressive Democrats and the various organizations, such as Tammany, which throve upon local patronage and contracts in large Democratic cities. The support of the latter gave Champ Clark of Missouri, the speaker of the House of Representatives, a clear majority on nine ballots, but he could not obtain the two-thirds majority required by the rules to nominate. The support of William Jennings Bryan

WOODROW WILSON

finally brought a two-thirds majority to Governor Wilson, who thus became the Democratic nominee, with Thomas R. Marshall of Indiana as the nominee for vice-president. Wilson proved a good candidate and in the election the Democratic ticket was successful, receiving 435 electoral votes against 88 for Roosevelt and 8 for Taft. But the combined popular vote for Roosevelt and Taft exceeded that for Wilson by more than 1,300,000.

A Political Reformer in the President's Chair

When President Wilson entered office he had the same elements in his own party for enemies that wrecked Cleveland's two administrations. On March 4, 1913, he delivered his first inaugural. He appealed to the forward-looking people throughout the country. "Here muster not the forces of party," he said, "but the forces of humanity." In this he reminded men of Jefferson's first and Lincoln's second inaugural. He called Congress in extra session early in April, addressing the two houses in person, thus breaking a precedent of more than a hundred years. From time to time after that he went before Congress with parts of his plan of general national reform. For more than two years he held that body to a strenuous task. Before his first term drew to a close a great far-reaching scheme of legislation was fairly completed. The tariff that had broken President Taft was reformed downward to a general average of 25 per cent. And a board, led by a tariff expert, was set up to study tariffs and make recommendations to the country. The Clayton anti-trust law was enacted, and the Federal Trade Board was organized to supervise its workings and likewise keep the country informed on the subject of trusts and interstate trade. The Federal Reserve banking system was established against the protest of organized bankers, and a board of control was set to work administering the system. For the first time in American history, finance and credits were placed under government direction. A national income tax, to be levied according to wealth and not according to population, was enacted. It was a graduated tax, its aim being social as well as financial. A farm loan act designed to give cheap and easy credits to farmers and tenants, with a board of operations, closed this series of reforms. They were far-reaching and they are not likely to be repealed. No other president ever secured from Congress so many important laws. No other American laws were ever enforced with greater effectiveness.

While Congress labored over the legislative program, President Wilson announced, and gradually if painfully worked out, a new foreign policy. Congress had enacted a Panama tolls law in 1912 that violated the Hay-Pauncefote treaty of 1901 with Great Britain. Wilson persuaded Congress and the country to repeal this law. President Roosevelt had "taken Panama" in 1903 to enable the United States to build the canal. (*See* Panama, Republic of.) All Central and South America was alarmed at what was styled "American imperialism." Wilson addressed South America when he spoke at Mobile, Ala., in October 1913, saying that "the United States would never again seek one additional foot of territory by conquest." President Taft had helped set up a financial arrangement with China whereby American banks were to coöperate with European banks in lending large sums to China, the understanding being that governmental pressure would be applied in the event that collections proved difficult. Wilson announced soon after his inauguration that he would abandon this so-called "dollar diplomacy." The people of Mexico, wearied with the exactions and corruptions of the Diaz régime, had recently overthrown Diaz and set up Madero as a reform president. Huerta caused Madero to be shot and made himself master of the country. Wilson refused to recognize a man "whose hands were stained with blood." He endeavored in "watchful waiting" to aid the Mexican people to find a government to suit themselves. Throughout Wilson's two terms that policy was adhered to against the bitterest opposition and this restored in large measure to the United States the good will of all Spanish America.

The President Insists on Neutrality

Before the country was asked to vote its approval in the elections of 1914 upon this new and far-reaching policy, Germany plunged all Europe into war (*see* World War). Americans as a whole were then little acquainted with international politics. The Democratic party, which Wilson represented, was even less informed on European affairs than were the Republicans. Moreover, the country contained millions of Germans who still thought in terms of their fatherland; millions of Irish who could never think anything England did was worthy of approval; and yet another group, less distinguishable, who thought the cause of Engand the cause of all mankind. With these national, party, and racial conditions known to all men, Wilson called upon the country to be neutral even "in spirit." At once all the interested elements of the nation began vigorously to attack his policy. Great industrial establishments soon began to manufacture munitions for the Allies, Germany being hindered from giving contracts by the fact that the British fleet controlled the sea. The Allies sold their great industrial and railway holdings in the United States and applied the money to their immense purchases. For the first time in American history that country ceased to be a debtor to Europe; it quickly became a creditor on an unprecedented scale. In all this Germany was losing. The Germans endeavored through a feverish propaganda to counteract the drift of economic life. The British countered in this. Ardent appeals were made to all racial groups. Unwilling to await the reaction of public opinion the German agents blew up railway bridges and brought on strikes in munition plants. They at last warned Americans to keep off the ocean lest they be sunk by German submarines. In May 1915, the *Lusitania*, a British transatlantic steamer, was sunk, and more than 100 Americans,—men, women and children—were drowned. Neutrality either in fact or in spirit seemed impossible. Yet Wilson, speaking to incoming immigrants a few days after the *Lusitania* went down, said there was such a thing as being "too proud to fight."

It was as difficult to be president in those days as it was when Washington was seeking to maintain a similar neutrality in the struggles between Revolutionary France and England in 1793–96. At a critical moment in August 1916, when American railroads were bearing their greatest burdens of munitions and supplies for the Western Front in Europe, and when American economic life was considerably deranged, the railway workers of the country decided to strike for better wages and for the eight-hour day. Wilson accepted the worker's point of view and asked Congress to enact, in the greatest haste, what is known as the Adamson law, granting what they asked. His recommendations also covered the whole railway labor problem, including the guarantee to the government in the future of absolute control, in the interest of the public. The latter recommendations did not receive serious attention.

Wilson was renominated in 1916 upon a peace platform. Charles E. Hughes, the Republican candidate, stood upon an even more positive peace platform. Wilson was reëlected with a plurality of nearly 600,000 votes; but the issue was for some days in suspense, and the change of 2,000 votes in California would have so altered the electoral vote as to give victory to Hughes.

Immediately after the result was known, President Wilson began to prepare a plan for effective American mediation looking toward a lasting peace, and sent for the ambassadors to England and Germany, while his confidential friend, Edward M. House, held conversations in New York with the representatives of the warring powers. With the apparent purpose of forestalling this effort of the President, Germany offered on December 12 her famous plea for a peace conference without any indication of the terms Germany would accept. Nothing daunted, Wilson continued his efforts, and on Jan. 22, 1917, he embodied his peace proposals in a speech to the Senate. He talked of a "peace without victory" and laid down several of the points later included in the famous fourteen. The Allies rather resented his suggestion of a drawn battle. Germany replied by announcing, on January 31, her campaign of unrestricted submarine warfare, and indicated to all neutrals the narrow lanes on the seas through which a few designated ships might pass. Shortly afterward the "Zimmermann note" fell into the hands of the government, in which Germany offered Texas and other American territory to Mexico if that country would join Japan in attacking the United States.

Wilson answered Germany's submarine declaration by dismissing the German ambassador (February 3) and asking Congress for a declaration of armed neutrality (February 26) which could hardly fail to become open war within a few months. A "handful of willful men" in the Senate defeated the armed neutrality measure in spite of great majorities in its favor. Nevertheless the government began in earnest to prepare for war. On April 2 Wilson addressed both houses of Congress asking a formal declaration of war. On April 6 Congress declared war by overwhelming majorities.

This meant American intervention in European affairs, a dangerous thing in view of the history of the country and the many racial antagonisms in American life. The President promptly made it a war for democracy. In all his declarations, from April 1917 to October 1918, he preached a crusade for democracy. In that way he influenced and moved the whole world, lifting the more liberal elements of the western Allies to a higher level of idealism, and putting the imperial-

WILSON'S ADMINISTRATIONS
1913-1921

17th Amendment, for Election of Senators by the People (1913).
Underwood-Simmons Tariff lowers Duties.
Federal Reserve System of Banks created.
Federal Trade Commission created (1914).
Clayton Anti-Trust Act passed.
Graduated Income Tax Law passed.
Panama Canal Tolls Act repealed.
Panama Canal opened.
Many Arbitration Treaties negotiated by Secretary of State Bryan (1913–14).
Neutrality declared in the World War (1915).
Tariff Commission created (1916).
Adamson Railway Employees' Law enacted.
Expedition to the Mexican Border.
Wilson reëlected on a Peace Platform (1916).
Proposes "Peace Without Victory."
Germany announces Unrestricted Submarine Warfare (Jan. 31, 1917).
German Ambassador dismissed (Feb. 3, 1917).
War declared against Germany (April 6, 1917).
Two Million American Soldiers sent to France (1917–18).
"Fourteen Points" proposed as Peace Basis (Jan. 8, 1918).
Republicans gain control of House and Senate (1918).
President attends Paris Peace Conference (1918–19).
18th Amendment, for National Prohibition (1919).
Treaty of Peace with League of Nations Covenant submitted to Senate (July 10, 1919); fails to receive two-thirds majority (Nov. 19).
President stricken on speaking tour in behalf of the Treaty (October 1919).
Woman Suffrage established by 19th Amendment (1920).

ists of Germany and her supporters upon a lonely defensive which was most difficult to sustain. In order to make these American ideals known, President Wilson created the Committee on Public Information, headed by George Creel and guided by a group of college professors and journalists of the more democratic type. This publicity bureau, in daily touch with the President, played as great a rôle in bringing the war to an end as did many of the generals of the Western Front. It was a battle of ideas as well as a battle of guns.

America's Wonderful Mobilization

The moment war was declared, the President showed the greatest energy. The industrial forces of the country were promptly organized under the leadership of a Council of National Defense. In similar manner the railways were brought under a government leadership whose business it was to economize railway space and tonnage. The scientific talent of the time was organized for promoting invention and for adapting the engineering resources of the country to the new emergency. Contrary to the habits of Anglo-Saxon communities, universal conscription was promptly enacted, and before mid-summer of 1917 immense training camps were opened at convenient points and millions of young men were speedily collected for intensive training. The munition plants already engaged in supplying the armies of England and France continued their operations, while the early contingents of the regular army and the National Guard were supplied with guns and shells from the stores of the Allies. A national Shipping Board was set to work to build millions of tons of shipping, and hundreds of millions of dollars were supplied makers of aircraft both for devising the best types and for building up-to-date planes, although much of these appropriations was apparently wasted. Altogether 2,000,000 soldiers were placed on the Western Front before armistice day, Nov. 11, 1918, and about 3,000,000 more were in the training camps. The personnel of the navy was raised from less than 100,000 to more than 300,000. The fighting efficiency of the American forces, both on land and on sea, was of the highest character. Twenty-five billion dollars were spent in winning the war and $10,000,000,000 were loaned to European enemies of Germany. These vast sums were raised from direct taxation and from loans made by the people at low rates of interest. By means of the income and excess profits taxes more than $3,000,000,000 was raised in the fiscal year ending June 30, 1918, and twice that amount was raised for the next year. The Federal Reserve banks and the Treasury conducted the far-reaching loan campaigns at small cost to the country. In no other war was there ever shown such a just distribution of the burden of taxation. Nor were the bonds of previous wars sold at par and without "rake-offs" to the brokers. Wilson was the soul of a vast idealism which he in large measure inspired and which the dangerous condition of the world aided him in calling forth.

Just as the American army was driving the Germans before it in the Argonne, and another army was being formed for a "drive" upon Metz, the strongest position of the enemy, the Central Powers began to collapse. Bulgaria surrendered at the end of September. A few days later Austria surrendered to Italy. On October 5, Germany began negotiations with the President, proposing the Fourteen Points—terms which Wilson had announced for America and the Allies on Jan. 8, 1918—as the basis of settlement.

The advantages of a "war for democracy" had been so great that few had challenged Wilson during the struggle. But freedom of the seas, self-determination of peoples, the greatest measure of free trade, and a league of all nations organized to prevent wars, seemed quite a different thing when claimed by the Germans as terms on which they would surrender. The great problem of Wilson's life was at hand demanding solution. The German proposals came in the midst of the congressional elections of 1918. The fear that the liberal terms of Wilson might be accorded to Germany, against whom all men had been called to fight to the uttermost, was a determining influence. The economic opponents of Wilsonism united with the racial groups of the country who had been most affronted at the declaration of war upon Germany or at the making of what amounted to an alliance with Great Britain. In spite of an appeal of the President to the people to return a Democratic majority to both houses of Congress, to avoid divided authority, the Democrats lost the election upon a plurality of more than 2,000,000 votes.

A few days after the election, Nov. 11, 1918, the armistice was signed. Its basis was the Wilson points above mentioned, except that Great Britain obtained the omission of the freedom of the seas. When Congress opened, although it was still Democratic on safe margins, it became clear that the President could not lead it as he had hitherto done. A third time in his life he was confronted with that division of authority which he had lamented in his first studies upon the subject of government at Princeton, 1907 to 1910, in the governor's office of New Jersey in 1912, and now in Congress at the greatest moment of his life and of world history.

The Peace Conference and the League

He sought to carry out his policies, in spite of the fatal defects of the American situation, by going in person to Paris and there in the assembling Peace Conference persuading Europe of the value of democracy and idealism. All European governments had agreed to his fourteen points. For two years the Western Allies had been accustomed to his leadership. But the French parliament announced by an overwhelming majority that France would not accept a Wilsonian peace. The British, on December 14, just as the President arrived in Paris, announced in a national election that Germany must pay to the "last farthing," which was directly opposed to the Wilson policy. Italy was known to stand defiantly for an imperialist peace in the Adriatic. Europe had quickly rallied against the President. The victory was too complete for men's cupidity. Against this Wilson endeavored to stir the democratic forces of Europe. In this he was treading dangerous ground. If he went too far, general revolution might ensue. That would endanger all. When the Conference met, Wilson stood absolutely isolated. If the peace conformed to his view, it would be because he begged and persuaded men, not because he had a mandate either from his own country or because of any tangible support in Europe.

The peace as agreed upon in June 1919 did contain many of his ideas. Many new states appeared on the map of Europe, Poland and Czecho-Slovakia being the most important. The League of Nations was definitely provided for. Backward countries were to be governed under mandates by the powers supposed to be best suited to the work. And there was to be general disarmament. These were Wilson ideas. But the Germans were to be subjected to many harsh terms, chief of which was the indeterminate reparations which Germany was to pay. It was a compromise, but as such Wilson defended it to all the world. On July 10, 1919, he laid the treaty before the Senate. That body, already organized by his opponents, prepared to undo whatever was known as "Wilsonism" in the treaty.

Rejection of the League

Meanwhile Wilson went before the country to defend his work. He was well received. But after a trying campaign, which took him to California, he was stricken dangerously ill at Wichita, Kan., late in September. He hastened to Washington where he kept to his bed many months. The violent and bitterly partisan debate in the Senate continued till March 1920, when the treaty was returned to him with "fourteen" reservations. Only one of these was really important, the one which proposed the elimination of Article X from the covenant of the League of Nations. From the Wilson point of view no League of Nations could function without the support of an international army or navy in possible contingencies. He refused to accept any reservation which would have destroyed the needful sanction.

For more than a year the government had been a divided house. There was nothing to do but await the next election. When the Republican national convention met in Chicago, in June 1920, its decision was of course against the President. Its platform assailed his foreign policy and condemned the covenant he signed at Paris. The Democratic national convention, which began in San Francisco June 28, made a great show of enthusiasm for President Wilson and his achievements, but its nomination of James M. Cox was dictated by the element within the party which had always hated and feared the President. Governor Cox, however, at once conferred with Wilson and fought valiantly for the League of Nations, though he was evidently willing to accept certain reservations. The result was an overwhelming Democratic defeat.

After his retirement from office, Mr. Wilson continued to make Washington his home. He discontinued all political activity, save for a few letters and public utterances in favor of the League or against its opponents. Though the left side of his body was paralyzed, his invincible will brought about a partial recovery and held death at bay for more than four years.

When the end finally came on Feb. 3, 1924, it brought a widespread sense of personal loss such as the country has rarely seen. The whole western world mourned him as one of the greatest figures of contemporary history. Whatever may be his ultimate place in the hall of fame, he indisputably exercised a deeper influence over world affairs than any other American president. He was buried simply and without pomp, as he had lived, in the National Cathedral of St. Peter and St. Paul at Washington.

WINDMILLS. As long ago as the 12th century men had learned to use the power of the wind to grind corn and pump water by means of windmills, which were introduced into Europe from Saracen countries. Today you find these picturesque structures on the farms of most civilized countries, where they form the cheapest power obtainable for farm tasks where continuous operation is not necessary. Within recent years the gasoline motor is in many places displacing windmills on the farms, particularly where the winds are not to be relied on, and where large power is needed.

Windmills are of two chief types: the older type which lends such charm to the landscapes of Holland and other parts of Europe, with four or six huge sails 30 feet or more in length; and the modern or American type, which has many fan blades arranged in a wheel usually 12 or 16 feet in diameter, mounted on wooden or steel framework towers from 50 to 70 feet high.

In the older type the sails—which are great arms usually covered with canvas—are kept facing the wind either by rotating the entire tower or by moving the dome to which the sails are attached. This is done sometimes by hand, sometimes by a rudder or vane at right angles to the sails which automatically shifts the dome when the wind veers. In the American type the vane is used almost exclusively.

Occasionally, however, American windmills are constructed so as to revolve in the same direction as the wind. This class has one-half its paddle-wheel fans cased in or arranged to fold and thus be guarded from the action of the wind. Otherwise they will not revolve, since the pressure on the two halves will balance. Such windmills are of little use except when the wind blows their way.

Countries that lack coal are developing wind motors, as for instance Denmark. A German type is so arranged that uniform motion is imparted to a dynamo despite varying wind velocity. The wind motor to drive generators for the wireless telegraph and telephone on airplanes is much more complicated, for the chief difficulty at all times, even on land, is to get a constant speed of revolution.

WINDS. Have you ever thought how different the world would be without wind? You couldn't fly a kite; the ocean would have no waves; windmills could never turn; Columbus could never have sailed across the ocean. Not merely this; the winds are now remaking, scouring, sculpturing the face of the earth, as they have done for ages past. After running water, wind is the greatest erosive force in wearing down rocks and hills and scooping out canyons and valleys. Here it picks up loose sand and rasps, gouges, and polishes the rocks exposed to its blast; there it dumps sand and dust transported for miles, sometimes making, sometimes destroying, fertile soil (*see* Sand). If you want to see what winds can accomplish, look at the section of China, larger than all France, which is overlaid with deep rich *loess* brought by dust-laden winds from Central Asia; then glance at the Desert of Gobi, where great cities lie buried and forgotten under sand heaped over their graves by the wind.

Of all mysteries, the movements of the air have long been among the most baffling. "The wind bloweth where it listeth, and thou hearest the sound thereof, but canst not tell whence it cometh and whither it goeth," expresses about all that it was thought possible to say on the subject until comparatively recent times.

Fortunately for the sailor the proverbially fickle wind is, in general, subject to fewer fluctuations on sea than on land. Most of the following generalizations in regard to the distribution of winds around the globe apply more strictly to ocean than to land.

Around the Equator is the belt of calms, or *doldrums*, so oppressive and unpleasant that we say a sulky person is "in the doldrums." This belt, from about a hundred to several hundred miles wide, is blanketed with clouds from the moisture gathered by the trade winds on each side.

The Famous "Trade" Winds

To the south of the doldrums blow the southeast *trades*, and to the north the northeast. Bright skies, clear air, freedom from storms, and steadiness of the fresh brisk winds make the trade wind region as beloved of the sailor as the steaming sultry doldrums are detested. In the tropics, the most desirable residence sites are exposed to the trade winds. Although the trade winds are exceedingly valuable to commerce, their name has no reference to that fact. The original meaning of "trade" was a path or beaten track; and so the trade winds are winds that blow always in the same direction. In general, the poleward limits, north and south, are about latitude 30, but on the eastern side of both the Atlantic and Pacific oceans the trade wind is sometimes felt as far north as latitude 40. The South Indian Ocean is the "heart of the trades," for there they have their greatest strength.

At the outer poleward limits of the trade-wind belts are the calms of Cancer and Capricorn respectively, the former sometimes known as the *horse latitudes*. Here the skies are clear, unlike those of the steaming doldrums. One story offered in explanation of the name "horse latitudes" is that vessels with cargoes of horses for the West Indies were often becalmed here so long that the supplies of water gave out and it was necessary to throw the animals overboard.

North of the calm belt in the Northern Hemisphere and south in the Southern Hemisphere are the regions of what are called the *prevailing westerlies*. The "brave west winds" attain their greatest strength in both the Northern and Southern Hemispheres in the "roaring forties." In the Northern Hemisphere land occupies so much of this portion of the globe that the eastward course of the air currents is greatly complicated by local disturbances of the air, and in particular by the vast atmospheric eddies called *cyclones* and *anticyclones* (*see* Storms).

We have named some of the winds, but have not yet solved their mystery. What causes them?

There are two great factors involved in the motion of the winds. These are the rotation of the earth and the inequalities in the heating of its atmosphere, especially the difference between the amounts of heat reaching the polar and equatorial regions, and the difference in the absorption of heat by continents and by the waters of the oceans.

The Hot Draft at the Equator

The general circulation of the air has been explained thus: In the region of the Equator the great heat of the nearly perpendicular rays of the sun causes the air to expand and rise. Its place is taken by cooler and heavier air from both sides, and since the rising currents are stronger than the horizontal movements this region is for the most part calm.

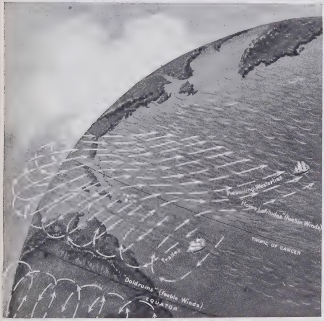
But this is not the entire explanation. If this were all, the "trades" would blow due north or south, instead of southwest or northwest. We can see why if we trace a current, say from Porto Rico.

The air over Porto Rico is, of course, traveling eastward with the land, because of the rotation of the earth. When it starts south it keeps this eastward velocity; but it blows over land which is traveling eastward at a faster rate, owing to the greater diameter of the earth at that point. Therefore the wind seems to be blowing somewhat to the westward, as well as south. Since winds are named for the direction *from which* they come, the current is the "northeast trade" of the Northern Hemisphere. It must be remembered that the trades do not blow westward with the full velocity the difference in rotation speed would give them. Much of it is absorbed in friction, and only a small portion remains. Unless this were so, the earth would be swept continually with hurricanes.

The air which rises from the Equator starts toward the poles in each direction. These upper winds have an easterly drift, imparted by the eastward rotation of the region from which they start; and since points near the poles do not travel as many miles eastward in an hour as do points on the Equator, these upper winds come to earth at points farther east than those from which they started. This causes them to settle as the "prevailing westerlies" of middle latitudes. Recent studies, however, have indicated that the movements in the upper air are more complex than this. Probably the time will come when this simple explanation will have to be modified.

The various periodic winds, or local modifications of these "planetary" winds, are also caused by differences in the heating of the atmosphere. The most striking examples are those which result from the fact that land cools and heats more rapidly than water, so that not only is it colder in winter and hotter in summer, but it is also cooler at night and warmer by day than the lake, sea, or ocean near it. In Asia the seasonal differences are so great as to produce the famous *monsoons* blowing from land to sea in winter and from sea to land in summer. The changes are most marked in India, Siam, and the Malay Archipelago. During the winter, cold northeast winds from a region of high pressure in northern Siberia blow over India; this is the dry or winter monsoon. During the summer the heated air over the land rises, and cool winds from the Indian Ocean flow in to take its place, delivering the moisture with which they are laden in the form of heavy torrents of rain. This is the wet or summer monsoon. Similar summer and winter reversals of wind directions take place also on the east coast of Africa, the north coast of Australia, and in Texas; and on the Pacific coast of North America and in Spain there is a decided seasonal change, not amounting to a complete reversal. Winds due to the same cause are felt about the Great Lakes.

THE "TRADES" AND "PREVAILING WESTERLIES"



Here we see the great wind currents flowing in toward the equator to form the trades, and the high return currents settling to earth beyond 30 degrees north latitude. Along the equator, where the air is rising, is the region of the "doldrums," where sailing ships lie and steam in the torrid heat for lack of wind, while between the belt of "trades" and "westerlies" are the "horse latitudes," likewise regions of feeble winds. The reason why the "trades" and "westerlies" do not blow due south and north is given in the article. This system of winds is duplicated in the Southern Hemisphere, with, of course, corresponding differences in direction.

Day-and-night breezes prevail on many shores—a landward breeze during the day to take the place of the heated air rising from the ground, and a seaward breeze, or outflowing of cooled air from the land to the comparatively warm water at night. Another day-and-night wind is the mountain-and-valley breeze, occurring particularly where long narrow valleys open on a wide plain below. During the night the cold air next the ground on the heights drains down the valley as a moderately brisk breeze; during the day the heated air from the plain rises like a draft "up chimney" as a faint, sometimes scarcely perceptible, breeze along the valley.

Among irregular local winds which yet are sufficiently individualized to have names are the *blizzard*, a high north wind with snow which is the same as the Siberian *buran;* the *sirocco* of Italy and Spain, a hot south wind; the *chinook*, a wind which blows down the eastern side of the Rocky Mountains, becoming heated by compression during its descent, so that it melts snow and sometimes withers vegetation (it is the same as the Swiss *foehn*); and the cold *mistral*, a strong northwest wind which blows from the Alps through southern France and other parts of the Mediterranean coast region.

WINDSOR, ENGLAND. With gleaming gray towers and battlements "bosom'd high in tufted trees," reflected proudly in the winding Thames, Windsor Castle, the ancestral residence of English sovereigns, towers over the river. Its 80-foot Round Tower or Keep was built by Edward III as a meeting place for the Knights of the Garter. This place was selected as it was supposed to be the site where King Arthur once had his illustrious Round Table. Later the Round Tower was used as a prison. Albert Chapel in the Lower Ward once belonged to Cardinal Wolsey and was restored by Queen Victoria. In the flamboyant Gothic chapel of St. George are buried Henry VI, Edward IV, Henry VIII and Jane Seymour, Charles I, George III, George IV, and various other members of royal families. On the east in the midst of a beautifully arranged garden adorned with bronze and marble statues is the Upper Ward with the private apartments of royalty, the visitors' rooms, and the state apartments. These last include the great throne room and St. George's Hall, where meetings of the Order of the Garter are now held.

Outside, by the Home Park south of the castle, are the $350,000 Royal Mews or stables. A little farther off at Frogmore is the mausoleum of Queen Victoria and her husband. From the Home Park the Long Walk, embowered for three miles with double rows of stately oaks and fine old elms, leads straight into the heart of the beautiful Great Park that is screened here and there with deep forest glades of elm and oak, beech and poplar, those patriarchs of the forest, old in time and rich in legend. At its southern edge gleams Virginia Water, a beautiful artificial lake; to the west lies what is left of the celebrated Windsor Forest, which since 1813 has been largely cut off.

From Windsor Castle one can look across the "silver winding Thames" where toward the north, whispering "the last enchantment of the Middle Ages," rise the antique towers and picturesque ivy-covered buildings of Eton College. This famous old preparatory school, under whose roof Gladstone, Gray, Shelley, Wellington, and many other noted Englishmen have begun their education, was founded in 1440 by Henry VI. Here Eton's thousand schoolboys are still drilled thoroughly in the classics; here the "dry bobs" still play cricket; and here the "wet bobs" linger on floating rafts or pontoons which fringe the Thames, or ply their oars up and down its waters.

The old town of Windsor is about 21 miles west of London. The castle is the chief point of interest in Windsor, whose name means "winding shore." Although founded by William the Conqueror as a mere fortress or hunting post, the oldest part now standing really dates from 1342—Edward III's day.

WINKELRIED (*vĭn′kĕl-rēt*), ARNOLD. The streams and hedges seaming the field of Sempach forced the Austrian knights to dismount, and the fierce heat of the July day compelled them to doff their armor; but they outnumbered the Swiss mountaineers four to one, and engulfed them hopelessly in bristling ranks of spears. Then from the point of the Swiss wedge sprang forth Arnold Winkelried and gathered a great sheaf of Austrian spears into his breast. The Swiss poured through the breach, and ere the day closed the Austrians were routed and Duke Leopold lay dead on the field.

Historians today doubt the Winkelried story, but it remains true that Hapsburg power over the Swiss Confederacy was broken at Sempach, July 9, 1386, and that Swiss sentries cry throughout the night, "All's well; remember Arnold Winkelried!"

WINNIPEG, MANITOBA. The rise of Winnipeg from a frontier trading post in 1871 to the third city of Canada is one of the amazing incidents of the last half-century. Where 50 years ago stood a hamlet of about 200 pioneers, the traveler today finds a metropolis with towering office buildings and huge factories, the greatest railroad center of Canada, its chief live stock market, and one of the world's largest grain markets. In place of the former prairie trails there are three transcontinental railroads, with more than a score of branches radiating in all directions.

The astonishing growth of this "Chicago of Canada" rests primarily on its geographical situation. Standing at the junction of the Red and Assiniboine rivers, midway between the southern boundary of Canada and Lake Winnipeg, it is the neck of the bottle through which pass the cattle and grain of the Northwest, and the center from which the manufactures of the industrial East are distributed to the smaller cities and farms of the western prairies.

But this alone does not account for Winnipeg's greatness. The factor which made possible its development as a manufacturing center is the boundless electric power supplied from the Winnipeg River, 60 miles distant. All Winnipeg's coal must be brought great distances, so without this cheap power manufactures could not have succeeded in competition with centers nearer coal supplies. The greater part of Winnipeg's electric power is developed in a great hydroelectric plant owned by the city, and it is sold to consumers at a low rate. Engineers say that there is enough undeveloped power to run all the industries of a city of 1,500,000 population. The manufacture of food products, large flour mills, farm implements, dairy products, clothing, harness, structural steel, lumber products, and leather goods are among the leading industries. Water is brought by a great aqueduct, nearly 100 miles long, from the Lake of the Woods.

Winnipeg is a city of wide streets and boulevards, with many parks and playgrounds. It is the capital of Manitoba and the seat of the University of Manitoba, the provincial agricultural college, and several other educational institutions.

The site of Winnipeg has been occupied since the early days of the Canadian fur trade, the first post (1738) being known as Fort Rouge. Fort Garry, the nucleus of the colony sent out by Lord Selkirk in 1812, gave its name to the settlement until 1873, when the city was incorporated and named "Winnipeg" (Murky Water) from the lake 50 miles to the north. Population, about 195,000.

WINTERGREEN. Deep in the cool northern woods the dainty little wintergreen nestles, a tiny evergreen much prized for the peculiar aromatic oil secreted in its glossy leaves. Essence of wintergreen is a favorite flavoring agent in confections and in medicines.

This small trailing shrub has a stem from three to six inches high, and the delicate pinkish-white urn-shaped flowers are almost hidden by the oval leaves.

Scientific name, *Gaultheria procumbens*. The plant grows wild in the mountainous districts in southern Canada and northern United States, and in many parts of England. It is also known as the tea-berry, checkerberry, box-berry, jersey tea, spice-berry, and ground holly. The name "wintergreen" is also popularly applied to various other genera of the family *Ericaceae*.

PASTIMES on KING WINTER'S PLAYGROUNDS

WINTER SPORTS. When the lakes and streams are frozen and snow lies deep on the hills and valleys, the season of winter sports is in full sway. With the first ice on the ponds the skaters turn out for one of the finest pastimes of the year—skating over the transparent surface through which one can look at the water plants and grasses growing on the bottom.

The sport of skating is at least a thousand years old and probably much older. There are references to it in many of the early books of continental Europe, and still earlier mention in the Norse sagas of Iceland. The first record of it in England was in the 12th century, when skates were made from the brisket bone of an ox and fastened by thongs to the sole of the skater's boot. The practice at that time was to move by means of an iron-shod stick repeatedly thrust into the ice. The next step in the evolution of skates was an iron runner fastened to a wooden frame, used in the 14th century. From early beginnings of that sort the modern steel-bladed skate was developed. Three styles are in common use today—the racing model which is 14 to 18 inches long, with a thin flat blade and a tubular steel frame; the hockey skate with a flat blade, somewhat shorter than the racing model; and the "rocker" which is used for general and fancy skating. The blade of the "rocker" instead of being flat is slightly convex, and permits the skater to turn sharply without lifting his skates from the ice.

Skating races and exhibitions of fancy skating form a part of most winter carnivals. Recently there has been a steady increase of interest in the art of fancy skating, which includes the performance of many intricate revolutions upon the ice. This graceful sport requires good balance, a sense of rhythm, and no little athletic ability.

An exhilarating pastime is made possible by the use of a small sail which the skater holds in his hands and shifts according to the course he wishes to follow. The same principles that hold good in boat sailing are used in skate sailing. An essential, of course, is a fairly large area of ice.

When the snow spreads its thick blanket over the ice, the lover of winter sports may be compelled to put away his skates, but he still will have plenty of opportunity for enjoyment in the open. On his snowshoes he can tramp across fields and over the hills into the forest, penetrating with ease regions where in the summer he would find the going extremely difficult.

The northern Indians were the first to make use of snowshoes, which they found a necessity in winter traveling. Probably the first snowshoe was a thick little fir tree which some ingenious red man tied to his feet. No one knows when the snowshoe with a wooden frame and a webbing made from strips of skin was invented. The modern snowshoes differ in no way so far as design is concerned from the snowshoes that the Indians were using when white men first came to America. Some of the racing shoes used in Alaska are more than seven feet long. The opposite of that type is the "bear paw," a short round shoe about two feet in length, used mostly for travel in thick woods or in brush. The snowshoe in most common use is oval, with a tail a foot or two in length. The frame is usually of straight-grained ash, and the filling is of strips of cowhide or caribou hide. There are two crosspieces—one at the end near the tail and one at the widest point of the shoe, just above the opening into which the toe fits.

The shoe is fastened to the foot by means of thongs or by a contrivance so adjusted that the back of the foot rises and falls freely as if the sole of the foot were hinged to the webbing at the rear edge of the toe opening. The adjustment should always be such that the tail of the snowshoe drags and is not raised when a step is taken. For a person who weighs from 125 to 150 pounds a snowshoe 4 feet long and from 12 to 14 inches wide at the point of greatest width is of good proportions. Either leather moccasins or flat-soled boots of rubber with leather tops, with at least two pairs of woolen stockings, are the proper footwear.

An hour's practice will enable the beginner to master the use of snowshoes for ordinary tramping, though of course he will not become an expert until he has covered a great many miles on the "raquettes," as they are sometimes called in the North. Running, jumping, sliding, turning quickly, and climbing are accomplishments that will come gradually to the enthusiastic snowshoer. The great advantage of the sport is that it enables a person to go almost anywhere across country, and to discover the real beauties of the winter landscape.

EASY TO LEARN

Snowshoeing is great fun for people of every age, and it is so easy to learn that even a little miss like this one can get around quickly after an hour or two of practice.

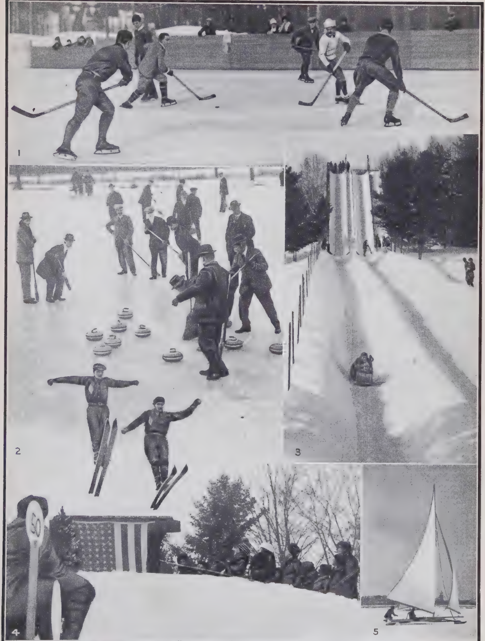
The ski originated, it is said, in Norway, and in fact it is often called the Norwegian snowshoe. On these long wooden runners one can go swooping down hillsides and across the open stretches of meadow and field at so swift a pace that it seems almost like flying. Their advantage over the Indian snowshoes is in their speed. Their disadvantage is that they are not so well adapted to use in the woods or in country where there is much brush. Skis should be of such length that when you place them on end you can touch their tips with your upstretched hand. For a person $5\frac{1}{2}$ feet tall that would mean a length of 7 feet or a little less. Usually they are between 4 and 5 inches wide. The equipment that goes with the skis includes heavy boots with heels, a harness to keep the foot in place on the runner and usually two sticks a little more than waist high with disks a few inches from the points to keep them from penetrating the snow too deeply. The ski is squared off at the heel and turned up at the toe, and is a little thicker at the center than it is at the ends. It should be made of wood that has a straight grain running parallel from end to end.

For many years skiing has been a favorite sport on the continent of Europe. In Switzerland it has always been a part of the winter carnivals that take place in the Alps, and the brilliant displays of the ski jumpers, who go shooting down the mountain sides, taking prodigious leaps of sometimes more than 100 feet, always attract the crowds of holiday makers. In Norway and Sweden skiing is the great national sport, and each year there are important meets to which runners are sent from the villages as competitors for the various championships. In the United States and Canada skiing is gaining in popularity every season. Some of the colleges maintain outing clubs which arrange for cross-country ski trips, and for an annual carnival much like the gatherings that take place among the Alps; and there are many places in the mountains of the northern states where during the holidays the inns and camps are crowded with people who have come to enjoy the winter sports. Young Americans in search of an exhilarating pastime can choose nothing more satisfying than ski running. Gliding down hills at high speed, running across country, and taking the lesser and greater jumps—each offers a separate thrill.

SKATING IS A SPORT TO MAKE THE BLOOD TINGLE

Skating is not hard to learn, and it is excellent exercise. These 10-year old boys are just starting a race, which is always lots of fun on the ice, particularly if several of the boys take tumbles. There are many games which can be played on ice once you have learned to skate easily.

FAVORITE WINTER SPORTS IN AMERICA



In every section where there is real freezing weather one or all of these sports can be enjoyed. 1. Men seeking relaxation and exercise in a game of Ice Hockey. 2. Curling, a game of Scottish origin, but now popular in Canada and parts of the United States. 3. Tobogganing, a thrilling sport, with first a sharp drop on a wooden slide, followed by a long "coast" down the slope of a hill. 4. Skiing, perhaps the most difficult of all winter sports. 5. Ice-boating, which requires considerable skill.

For a swift flight over hard packed snow, tobogganing offers sport that is almost as satisfying as skiing. The Indians were the first to use the toboggan, the name of which goes back to the Algonquin word *odabaggan*. The red men probably first used the toboggan for carrying their loads of food and supplies through the winter woods, but we may be sure that the Indian children soon took advantage of the toboggan for sport on the hillsides. The boys and girls of the northern tribes made the most of their opportunities in the winter time. They devised many snow games and undoubtedly found the same pleasure in the swift flight of a toboggan downhill that boys and girls do today who coast on their sleds and bob-sleds.

The Toboggan and the Bob-Sled

Toboggans vary in length from "single seaters" of four feet to 16- or 20-footers upon which a dozen persons may sit. They are made of long thin boards with the forward end curved upward. The steersman lies at the rear and guides the toboggan by his trailing feet. On the artificial slides made by scooping out a channel in the snow and banking the sides, or by building a trough of wood and filling the bottom with snow, there is little or no need of steering, for the toboggan remains within the narrow channel as it slips swiftly downward. Perhaps the most famous toboggan slide in the world is the one at St. Moritz, in the Swiss Alps, where people gather from all over the world to share the sport.

Bob-sleds or double runners are made by placing a long narrow platform above two single sleds. The person who sits at the front steers by placing his feet on a cross bar attached to the front sled or by two ropes fastened to the points of the forward runners. Little sleds and big sleds go down the hard packed roads that wind over the wintry hillsides. It is a sport that well repays one for the hard climb that comes after the swift flight to the bottom.

Sailing on the Ice

The winter pastime which requires the most elaborate equipment is ice boating or ice yachting, which has been an organized sport in the United States for 60 years or more. There are many places from Maine to the Rocky Mountains where the tall sails of ice boats are seen. On lakes and rivers of the northern states many followers of the sport get out their boats as soon as the ice forms. It is difficult to say when the first ice boat was made. Probably some ingenious boy placed runners on the bottom of a box, rigged a crude mast, and raised a blanket sail. From that small beginning by gradual steps ice boats have developed until now some of them weigh 3,000 pounds and carry 800 square feet of sail. In the most common form of ice boat a center timber forms the hull. To this is attached the "cockpit," in which sit the steersman and the passengers; at right angles is the plank on the ends of which are the runners. A third runner at the rear of the boat acts as a rudder. The mast is "stepped" upon a plate fastened to the center timber, just forward of the cross-plank. The two-sail rig—"jib" and "mainsail"—is the one in most common use, and of course the principles of handling are similar to those of water sailing. The speed that may be attained in a well-built ice boat with a large spread of sail is very high. It is said that the sail boats along the Hudson River often race the express trains which are speeding along on shore.

There is another form of ice craft, called a "scooter," which is really nothing more than a sailing skiff with runners on the bottom. It can travel over ice or through open water and can lift itself from the water to the ice with the power of the wind behind it. It was invented by fishermen who found it a convenient means of crossing partly frozen rivers and bays.

Though ice boating requires a more elaborate equipment than most of the other winter sports, this is to be said for it—that it is not difficult for an ingenious boy to construct his own boat, and he can do it at small cost. His homemade affair may not be as swift or as graceful as the expensive professionally made ice boat, but he may confidently count upon it to give him many hours of fascinating sport.

'WINTER'S TALE'. The King of Bohemia is revealed, in this romantic drama by Shakespeare, as a guest at the court of Leontes, king of Sicilia (Sicily), enjoying such hospitality from Queen Hermione that Leontes is seized with fierce jealousy. He forces the Bohemian guest to flee for his life, throws the queen into prison, and commands that her new-born babe, a girl, be carried to some foreign shore and left to die. He then summons Hermione to trial. To his confusion, an oracle from the god Apollo at Delphi declares that "Hermione is chaste, Leontes a jealous tyrant, and the King shall live without an heir if that which is lost is not found." Almost immediately, word is brought that the young Prince of Sicily, Leontes' heir, is dead of grief; and Hermione, until now dignified and firm in her sufferings, falls down as if she too were dead.

For sixteen years Leontes lives a remorseful life, bereft of wife and children. Then there arrives at his court a pair of runaway lovers, who prove to be the King of Bohemia's son, Prince Florizel, and his exquisite bride, the daughter of a shepherd of Bohemia. The Bohemian king follows hotly after. In fear of the king's rage, the old shepherd who has accompanied the fleeing lovers produces a jeweled chain and a letter that prove Florizel's bride to be, not the shepherd's daughter, but Perdita, the lost princess of Sicilia! One of the ladies of the court now invites the company to view a wondrous statue. As they gaze in admiration the "statue" comes to life, being indeed the injured and long-concealed Hermione, who, recovering from her faint, has lived in seclusion until the oracle should be fulfilled and Perdita found.

The prettiest incident in the play is that of the wooing between Prince Florizel and his "shepherdess." For the festivities of the sheep-shearing he has donned shepherd's clothes and thus obscured his rank, and has so decked out Perdita that she seems not a shepherdess but some fairy queen, whom he addresses in these words—

> What you do
> Still betters what is done. When you speak, sweet,
> I'd have you do it ever: when you sing,
> I'd have you buy and sell so; so give alms;
> Pray so; and, for the ordering of your affairs,
> To sing them too: when you do dance, I wish you
> A wave o' the sea, that you might ever do
> Nothing but that; move still, still so, and own
> No other function. Each your doing is
> So singular in each particular,
> Crowning what you have done i' the present deed,
> That all your acts are queens.

An interesting minor character is the light-hearted and light-fingered peddler, Autolycus, who "having flown over many knavish professions" has "settled only in rogue." He appears at the sheep-shearing singing his wares:

> Lawn as white as driven snow;
> Cyprus black as e'er was crow;
> Gloves as sweet as damask roses;
> Masks for faces and for noses;
> Bugle-bracelet, necklace-amber;
> Perfume for a lady's chamber;
> Golden quoifs and stomachers,
> For my lads to give their dears;
> Pins and poking-sticks of steel;
> What maids lack from head to heel:
> Come buy of me, come; come buy, come buy;
> Buy, lads, or else your lasses cry:
> Come buy.

WINTHROP, John (1588–1649). Because he feared that the "talents which God hath bestowed upon him for public service are like to be buried" if he remained in England, the Puritan, John Winthrop, crossed the Atlantic in 1630 as governor of the Massachusetts Bay Colony. To him the city of Boston owes its foundation, and except for brief intervals he served as governor of the infant colony until his death.

Winthrop had belonged to the landed gentry of England. He had been educated at Cambridge University, had read law, and had become an office-holder for a time. But the arbitrary rule of Charles I and the religious intolerance of Archbishop Laud had driven him from office and from home. The ideas of the man of his class, however, remained with him even in the new country. He speaks, for instance, in his 'History of New England' of the "commons" and the "meaner sort." He had a dread of "meer democracy" which came near to proving his undoing.

The people of Massachusetts Bay tired for a time of Governor Winthrop's arbitrary rule, and in 1634 they dropped him from the office which he had held for four years. Regardless of the fact that at four different times Winthrop was out of office, he continued to work zealously for the good of the colony. In 1643 he led in founding the New England Confederation, and he was elected its first president. He was a mild even-tempered man who reasoned out his course of action, and his decisions frequently saved the colony from Indian massacres and from interference by the English government. Even after his death his influence was a potent factor in the development of the colony.

WIRE. When you wake up in the morning rested after a good night's sleep, perhaps it does not occur to you that one of the chief reasons for your comfortable slumber is the fine wire network of the bedsprings on which your mattress rests. You look at your watch to see the time; the mainspring of the mechanism is made of the finest tempered and flattened wire. You may use a brush of fine wire to wash your hands and another to comb your hair. If it is dark, the electric light which you turn on is charged with power transmitted to you over steel and copper wires. Perhaps before you leave home you wish to use the telephone. Again thousands of miles of wire are at your service. Perhaps the fence that surrounds your home is made of woven steel wire. The street car which takes you to school or to work gets its power from the heavily charged trolley wires overhead. Or if you ride in an automobile or on a bicycle, wire entered into the composition of the spokes and springs, and the bridge you cross may suspend from cables of wire. Every time you use a pin or needle or drive a nail, the wire industry supplies you with the instrument. Heavy cables, which are simply a number of wires twisted together, haul you up and down in elevators. The sound from the piano whose music you may enjoy is largely the result of vibrations of finely attuned wires inside the instrument.

So you conclude, and justly, that the improvement in the manufacture of wire is one of the greatest steps forward that industry has taken in the last century. Perhaps it might not be too much to say that many of the most wonderful inventions of our age could never have reached their present high efficiency had it not been for the discovery of the method of making machine-drawn wire less than a century ago. The old methods of hammering the metal, and drawing it into wire were both laborious and cumbersome in comparison to modern practice.

The commonest wires used are made of steel or copper or alloys of both. Several other metals are used, however, the most common ones being nickel, platinum, silver, iron, aluminum, and gold. Metals used for wire must be capable of being drawn out (ductile) and of sustaining weight or bending without snapping. Platinum and gold possess these qualities in the highest degree; platinum has been drawn into wire one fifty-thousandth of an inch thick, a mile of which weighs no more than a grain. Wires such as these are used as spider-lines for telescopes and in the manufacture of scientific instruments of the most delicate accuracy.

Wire has been in use for many hundreds of years. It was known in Nineveh and Egypt in 800 B.C. It was made then and for many centuries afterward by beating metal into plates which were then cut into strips and rounded by further beating. Wire drawing was known in the 14th century, but the machinery used in this process and the Bessemer steel were not perfected until the last century. In modern wire plants the raw material, usually steel, is received in the form of small bars or billets. The billets are heated and conveyed to a set of rolls to be reduced in size. Finally, for ordinary sizes of wire the billet is rolled down to a rod smaller than a lead pencil. The heated rod is carried through a pipe to a coiling device which coils the rod. The coiled metal is cooled and taken to the drawing plant where it is drawn into wire of all sizes. First the scale which has accumulated is removed by an acid bath and the acid removed in an alkali bath. Next the rod with its point made small enough enters a bell-mouthed hole in a draw plate or die made of hard steel or, in some cases, of a diamond or ruby, and emerges from the smaller end of the hole reduced in size. The process of drawing the wire through smaller and smaller holes continues until the desired size is reached. As the metal is drawn finer it becomes harder and more brittle, so that from time to time it must be annealed to make it soft and tough and it must be constantly oiled as it is drawn through the dies or perforated plates. Fine wire may require from 20 to 30 drawings.

Barbed wire is an American invention credited to Lucien B. Smith and William B. Hunt. It has contributed enormously to the agricultural development of the western part of the United States where vast acreage made protection of crops and live stock virtually impossible. Machinery for the rapid production of barbed wire was devised in 1874 by Joseph F. Glidden and Phineas W. Vaughan. The typical barbed-wire machine of the present uses four reels of wire, each feeding one strand into the machine. Two of these strands run side by side and become the body of the finished wire. The others are run across one of these strand wires. At intervals the machine cuts a length from them, twists the lengths around the strand wire, and cuts points on them. After the strand wires pass the point where this is done, they enter machinery which twists them about each other. Once started, the operation of the machine is continuous, so long as wire is fed to it. If additional barbs are wanted, as in military barbed wire, additional cross-wires and machinery are used.

The use of barbed wire as a defense against attack in war has been a remarkable modern development. Wire defenses were used extensively by General Weyler against the Cubans, and later against the Americans in the Spanish-American War. Russian and Japanese commanders also constructed barbed wire defenses, as did the Boers in their war against Great Britain. But the full development of barbed wire entanglements as defense did not come until the World War of 1914–18, in which the various combatants are said to have used more than a million miles of barbed wire. These defenses were intricately built and proved tremendously strong against any assaults save those by tanks. Heavy charges of electricity added to their deadliness.

Steel wire and wire net have come into wide use in recent years as one of the materials to reinforce concrete for roadways and in buildings.

Insulation of wires for carrying electricity has become an industry in itself. Rubber, silk, cotton, jute, and paper are the substances most commonly used as insulators. The fiber insulation is wrapped spirally and protected by paraffin or some other preservative.

There are several systems of wire sizes or "gauges," the Brown and Sharpe, or American, being used largely for copper and alloy wires, and the American Steel and Wire Company gauges for iron and steel wires. In the Brown and Sharpe system No. 1 wire is 0.28930 of an inch in diameter; the largest, No. 000000, is 0.58 of an inch, and the smallest, No. 50, is 0.00088 of an inch in diameter. The American Steel and Wire Company's "music wire" gauge increases in size for the larger numbers, No. 1 for example, being 0.01 of an inch in diameter and No. 45 being 0.18 of an inch.

FLASHING WORDS *Through Space on* LIGHTNING WINGS

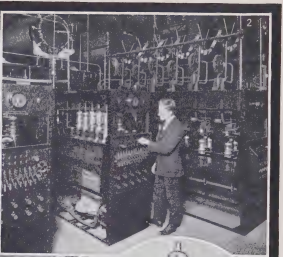
How the Wireless Telegraph and Telephone Do Their Work—The Waves of Electricity that Leap through the Ether with Their Messages—The Work of Maxwell, Hertz, and Marconi — The Marvelous "Detectors"

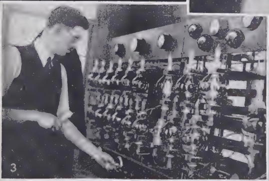
WIRELESS TELEGRAPH AND TELEPHONE. Wherever we go today, in city or country, we cannot travel far without seeing the long strands of wire raised high on poles or above roofs which indicate radio installations. We know that daily and hourly they are catching messages from a mysterious, invisible power that is hurtling through space above and all about us—messages ranging from weather reports to opera performances and bed-time stories. A few years ago radio was a scientific curiosity; today it is a household utility, almost as familiar as telephones.

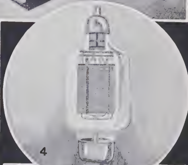
In order to understand this miracle of wireless telephony and telegraphy, we first must get acquainted with the two agencies which make it possible—electricity and the ether. The general scientific account of these is given elsewhere (*see* Atoms and Electrons; Electricity; Ether). Here we want rather to get a mental picture which will help us understand how radio works.

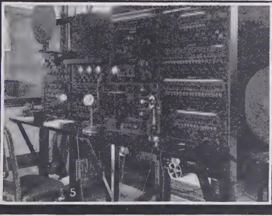
What, then, is "ether," the "foundation stuff" of radio? Imagine a giant bowl of jelly, a bowl a mile across. You know how a mass of jelly quivers at the lightest touch. In our huge bowlful, portions of the jelly of course can quiver in the same way. That is the first idea to get in mind, for ether's great property is that of quivering, or *vibrating*, just as jelly does.

Now imagine this jelly to be entirely transparent, invisible, and made of so light and thin a material that all substances, from huge buildings to tiny molecules of air, can move about in it far more easily









When you "tune in" to a radio program, do you ever stop to think of the complicated and costly equipment that is necessary for broadcasting? 1. The latticed steel towers of a broadcasting station. 2. Telephoning across the Atlantic. The final stage of a 150-kilowatt amplifier. 3. An 18-tube transmitter. 4. A "radiotron" transmitting tube or audion. Compare this with the audion on page 1799. Many types of tube have been developed, adapted to every purpose. 5. The control board of a broadcasting station. 6. Looking down from the top of one of the 820-foot towers of the great radio station at Rugby, England.

than any minnow gets about in the ocean. Imagine it permeating all matter, even the particles in what seems to us a solid wall, so that vibrations in it can pass through walls as easily as an ocean wave passes between the pilings supporting a wooden pier. Next imagine our mile-wide bowl of jelly grown into a bowl big enough to contain the entire universe, with worlds, solar systems, and stars flying about in it without resistance. Now you have a good picture of what scientists conceive the ether to be.

Electricity is just as easy to understand, if we describe it in terms of the so-called "electron theory." Electric current, so scientists tell us, consists of a swarm of negative electrons, or minute specks of negative electricity, flowing through a conductor. Each speck carries its "field"—that is, makes its electric influence felt through surrounding space. When many specks are present, they unite their individual "fields" into a strong combined one. An electric current then has two essential features: it consists of electrons, with their "fields," and these electrons are *in motion* through the conductor.

We come now to see how electricity and ether interact to produce radio-telegraphy and telephony. Go back to our bowl of jelly, and imagine a string of beads imbedded in it. If we give this string a jerk, what happens? The sudden movement of the beads distorts, or *strains*, the jelly in their vicinity, and this strain or distortion radiates outward through the jelly. If this radiating strain passes a second string of beads, it will set these beads in motion.

Much the same thing happens in the case of ether and electricity. The electrons may be compared to our beads, and the ether to the jelly. When one set of electrons moves suddenly—that is, when an electric current is created—this movement disturbs the ether, and the disturbance (called an *electric wave*) radiates outward, setting in motion any groups of electrons it encounters. This motion constitutes an electric current. So in order to send and receive radio messages we need only set up electric waves in the ether and then, by suitable instruments in a receiving station, harness the current created by the waves so that it will give audible signals.

Electrical Properties on Which Radio Depends

WE saw that an electric current has two essential features: (1) it consists of negative electrons; (2) these electrons are in motion. Various forces, such as friction in an electrostatic machine, chemical energy in an electric cell or battery, and mechanical energy in a dynamo, are used to produce this motion. If you do not understand these devices, master the explanations given elsewhere (*see* Dynamo; Electricity). The force which sets electrons in motion—that is, sets up current—is called *electromotive force* (abbreviated E.M.F.), *electric pressure*, or *potential*.

When this electric pressure acts steadily in the same direction, it produces a *direct current*. When it acts first one way, then the other, as in some kinds of dynamos and in transformers (*see* Transformer), it produces an *alternating current*. Such a current starts from zero strength, rising to maximum strength in one direction, falls off to zero, rises to maximum in the other direction, falls off to zero, and is ready to start in the first direction again. One such sequence of events, from a start in one direction, to the next start in the same direction, is called a *cycle*. The time taken to complete one cycle is called the *period* of the current, and the number of cycles a second is called the *frequency*. When the maximum strength varies from cycle to cycle, the current is called *oscillating*.

The character of an alternating current depends, however, not only upon how frequently the E.M.F. reverses direction, but also upon two other exceedingly important factors—the so-called "inductance" and "capacity" of the circuit.

We know that when a current passes through a wire, it creates a magnetic field around the wire (*see* Magnet). We know also that when the "lines of force" in this field move across a nearby wire, as they do when either wire changes position, or when the current changes in strength, an E.M.F. is generated in the second wire by the process called *induction*. Suppose now we have a current passing through a coiled wire, and its strength rises. As the increased current enters the first turn of wire, the magnetic field about it is strengthened and the lines of this field move across the other turns of the coil, generating or "inducing" an E.M.F. in them. Now, it happens that this *induced* E.M.F. opposes the original E.M.F. and therefore opposes the rise of current. It requires a fraction of a second to overcome this opposition and push the increased current through the coil.

In a similar way, when the original current falls, the induced E.M.F. acts *with* the original E.M.F. to preserve the current at full value—again opposing change, you see. The statement that induced E.M.F. always opposes the current change which creates it is known as Lenz's Law, and the amount of such opposition offered by a circuit is called its *inductance* (usually indicated by the symbol L).

Now suppose we have a circuit whose inductance is such that one hundred-thousandth of a second is required to get current going in it at maximum strength. Since a complete cycle must rise to maximum strength *in each direction*, maximum strength can be attained in such a circuit only by currents having a period of one fifty-thousandth of a second. In technical wording, one fifty-thousandth of a second is the *natural period* of such a circuit. Currents with shorter periods cannot get built up to maximum strength in either direction before the E.M.F. reverses direction. We say they are "choked down" by inductance. Hence, by changing the inductance of a circuit we can change its natural period.

When we want to increase the inductance of a circuit, we introduce an "inductance"—a coiled wire, with or without an iron core. If we want to change the period of the circuit from time to time, we use a "variable inductance"—a coil built in such a way that we can "switch in" more or fewer of its coils as we wish, either with a metal slider or a switch (Fig. 1).

So far we have considered an E. M. F. acting in a *closed* circuit—that is, in a circuit through which current can flow all the way around. What happens if we break the circuit, thereby stopping the flow, while the E. M. F. continues to exert pressure?

Obviously it will draw negative electrons from one side of the broken circuit, leaving a positive charge behind, and it will pack them into the other end, giving it a negative charge. But we know that among electric charges, "like repels like and unlike attracts" (*see* Electricity). Consequently, before this process has gone far, the negative electrons in one end resist the entrance of more negative electrons, and the increasing charge on the positive side resists the withdrawal of more negative electrons. When these attractive and repulsive (electrostatic) forces become equal to the E. M. F., further movement of electrons ceases, and the broken circuit is "charged."

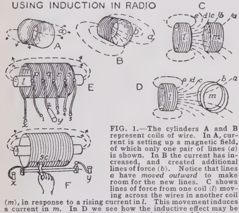


FIG. 1.—The cylinders A and B represent coils of wire. In A, current is setting up a magnetic field, of which only one pair of lines (*a*) is shown. In B the current has increased, and created additional lines of force (*b*). Notice that lines *a* have *moved outward* to make room for the new lines. C shows lines of force from one coil (*l*) moving across the wires in another coil (*m*), in response to a rising current in *l*. This movement induces a current in *m*. In D we see how the inductive effect may be lessened by rotating coil *m* so that vertical lines of force move between its turns of wire instead of cutting them, and the effect of lines other than vertical is reduced. This arrangement is a "variable inductive coupling," since varying the position of *m* varies the amount of current induced. In E the variable effect is obtained by tap wires and switch points. The circuit in which the induced current is to be used is connected with points *x* and *y*. When *y* is connected by the switch to switch point 2, as shown, the circuit takes only the current induced in segment *p*. Connecting *y* with switch point 3 "switches in" segments *p* and *q*, and so on. In diagram F the same result is obtained by moving the sliding contact *sc* to various positions. Both these devices may be used as variable inductances in a single circuit by passing the current directly through the "variable" coil.

If the ends of the circuit are left dangling in space, this "fully charged" point is soon reached. Suppose, however, we attach each end to a metal plate and bring the plates close together, being careful that they do not touch. This forms what is known as a *condenser*. The action in a condenser is as follows: the charge in the positive plate, acting across the small intervening space, tends to draw more negative electrons into the negative plate. The accumulated negatives in turn reduce the "back pull" the positive charge ordinarily would exercise. Obviously, therefore, a condenser enables a given E. M. F. to build up a greater charge than it could otherwise. If the distance between the plates or their relative position can be altered (a *variable* condenser), we can regulate the condenser's power to absorb charge.

When a condenser becomes charged, the flow of current stops and the system remains quiescent in its charged state (Fig. 2). In most cases, this result is brought about in a fraction of a second. But suppose the E. M. F., having charged the condenser, reverses its direction. Look at Fig. 2 and you can understand what happens. Before reversing direction—that is, while still acting in the direction shown—the E. M. F. has been drawing negative electrons from the wire to its right, and packing them into the wire and plate to its left. Now not only does it remove this pressure, but it tries to move electrons the other way. Naturally, the heaped-up negative electrons, responding both to the attraction of the positive charge and to the reversed E. M. F., rush back from left to right. If, by the time this "back-rush" is completed, the E. M. F. reverses *again*, we get a second surge to the left. Each such surge constitutes a current, and if the reversal of E. M. F. is rapid, these "back and forth" surges amount in effect to an alternating current.

Thus we see that while a condenser blocks the flow of steady, direct current, it permits the flow of alternating current. It also permits the flow of *variable* direct current, because the variations, by upsetting the electrostatic forces between the plates, permit compensating flows of electrons.

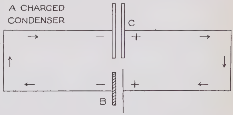


FIG. 2.—The E. M. F. of the battery (B) moves negative electrons as shown by the arrows until the "back pressure" of the charges on the condenser plates (C) equals the driving power of the battery. The condenser then is fully charged.

Still another action of the condenser is important in radio. If the heaped-up electrons on the left-hand plate were not in the presence of a positive charge—that is, if the plates were far apart—the negative electrons would rush back full force when released. But in a condenser the positive charge attracts the negative electrons across the gap between the plates and creates electric conditions which slow down the period of the circuit, just as inductance does. The power of condensers to affect circuits in these ways is called their *capacity* (symbol, C).

We can, therefore, alter the natural period of an alternating current circuit by varying either its capacity or its inductance. Which means we choose depends often upon the fact that an inductance does not break a circuit, and a condenser does. Steady direct current can flow, therefore, in a circuit having an inductance, but not in a circuit broken by a condenser.

Another important use of these properties is in what is called "coupling." Two circuits are said to be *coupled* when current in one circuit sets up or otherwise influences current in the other. The simplest type of coupling is electrical, and occurs when the two circuits are joined by metallic contact in such a way that part of the current flowing in one crosses through the connection to flow in the other. Circuits can also be coupled by taking advantage either of induction or capacity.

In our previous discussion of inductance, we saw the coil acting upon itself (*self-induction*). It is obvious that a coil throwing off lines of force will act in the same way upon a nearby coil in another circuit. This is what happens in the transformer (*see* Transformer). We can, therefore, couple two circuits *inductively*, by passing current through a coil, and placing another coil near enough to be affected by it (Fig. 1).

Capacitative coupling is similar. By attaching the ends of two broken circuits to condensers and placing the condensers in such position that they influence each other, we obtain a *capacitative* coupling. As in the case of inductive coupling, we can vary the effect by varying the relative position of the condensers.

Working Methods in Radio

WE are now ready to see how these principles and devices are applied in radio telegraphy. Let us begin with the methods used by Marconi in his early work. The essential feature of the transmitter (Fig. 3) is the passage of sparks across a gap (G) in the secondary circuit. By remembering that each spark marks a rush of electrons across the gap, you see how this apparatus achieves the "ether shock" which we compared to the shock given a bowl of jelly by jerking a string of beads imbedded in it.

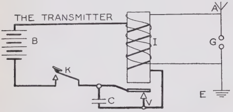


FIG. 3.—The key (K) is in series circuit with the battery (B), the primary circuit (indicated by heavy wire) of the induction coil (I), and the vibrator (V). When the key is pressed down, current from the battery magnetizes the core of the coil. This attracts the iron vibrator head, breaks the circuit, and releases the magnetic attraction. When released, the vibrator tongue springs back against the contact, restoring the circuit. This "make and break" induces a series of high-tension impulses in the secondary (indicated by fine wire). The antenna (A) and ground (E) become charged by each impulse, and discharge across the spark gap (G). Each discharge sends out a train of ether waves, and discharges continue as long as the key is down. The condenser (C) keeps the vibrator from sparking on the "break."

But what is the function of the antenna and the ground? Bear in mind that the spark will jump the gap as soon as the E.M.F. in the secondary is strong enough to overcome the air resistance in the gap. If the coil alone were used, there would be only a small charge present when the E.M.F. forced the spark across the gap, and this spark or charge would not give "ether shocks" strong enough for use in practical radio. But when the antenna and ground are introduced into the circuit, they act *like the plates of a giant condenser*, enabling a large charge to accumulate in the coil before the spark jumps.

The waves created by these discharges were received in Marconi's earlier systems by the arrangement shown in Fig. 4. The figure explains everything essential except the part played by the coherer. To understand the function of the coherer and other so-called "detectors," remember that the current between antenna and ground is alternating, while telephone receivers will work only on variable direct current. With the coherer this difficulty is overcome by using the alternating current of the antenna merely to establish a path for direct current from a battery, which operates the receiver. Thus the coherer acts like a switch, turning the battery current on and off. With electrolytic and crystal detectors the alternating impulses are "rectified," that is, converted into one-way pulses, by virtue of the fact that these devices have the property of offering much greater resistance

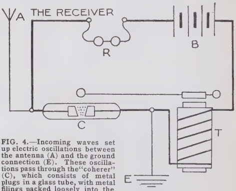


FIG. 4.—Incoming waves set up electric oscillations between the antenna (A) and the ground connection (E). These oscillations pass through the "coherer" (C), which consists of metal plugs in a glass tube, with metal filings packed loosely into the gap. The current causes the filings to align, or "cohere," across the gap. This closes the gap, and allows a current to flow from the battery (B) through the telephone receivers (R) and the "tapper magnet" (T). The magnet draws the hammer arm, causing it to tap the coherer tube and break up the alignment of the filings. Incoming waves restore the alignment, and thus a series of impulses from the battery passes through the receivers, giving a buzzing sound—short for a "dot" signal, and somewhat longer for a dash.

to electric currents in one direction than in the opposite. Among the crystals that may be used for this purpose are those of silicon, molybdenite, galena, carborundum, tellurium, zincite, and iron pyrites.

Since a receiving circuit will respond properly only to vibrations with a frequency corresponding to its own natural period, stations are "tuned" together by using variable inductances and condensers. Thus their antenna circuits are given the same period, and such stations will hear one another without being affected by currents from stations having markedly different periods.

Though it is really the periods, or vibration rates, which are tuned, operators commonly speak of tuning for wave-length. They do this because wave-length and frequency amount to the same thing in the end as descriptive terms. We know that radio waves travel with a speed of 186,000 miles a second. That is, one second after an "ether shock" has been created at any point, the effect of that shock will be felt 186,000 miles away, provided it is strong enough. If 100,000 waves are emitted in that second, each wave obviously will be 1.86 miles long, while if 1,000,000 waves are emitted, each wave will be .186 miles long. We therefore can describe the first wave as having a frequency of 100,000 or a wave-length of 1.86 miles, and the second as having a frequency of 1,000,000 or a wave-length of .186 miles, just as we prefer. The wave-length method has been thought handier because its numbers are shorter.

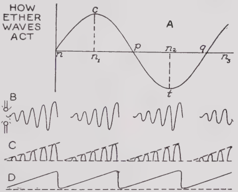


FIG. 5.—Though ether waves are not at all similar actually to water waves, being highly complex conditions of moving strains in the ether, they may be *represented* graphically by wavy lines like water waves, as in A. The level indicated by line n-n_3 indicates ether in normal condition, and the wavy line shows the amount of strain present at successive fractions of a second. When a radio set creates a wave, the strain increases rapidly, as shown by the rise of the wavy line from *n* to *c*. The strain then falls off to normal, shown at *p*, then to maximum value "below normal" at *t*, rises to normal at *q*, and the whole process repeats. The lines n_1-c and n_2-t indicate maximum strength above or below normal and are called the *amplitude* of the wave. "Amplitude" therefore is equivalent to "strength." In B we have a train of "damped" waves—that is, waves with decreasing strength, and therefore decreasing amplitude. In C the graph shows an oscillating current rectified by a detector. Wavy lines above the horizontal indicate current flows in one direction, and ordinarily there would be a corresponding portion below the horizontal for flows the other way. Here there are no portions below horizontal, because the "detector" permits current to flow in one direction only. The lowest diagram shows rectified pulses after being "enveloped" by the receiver, as explained on page 3764.

Aside from its greater power, modern radio differs from the earlier methods chiefly in the use of "continuous" waves instead of "damped" waves. In the earlier sets, the spark gap arrangement gave only a few thousand sparks a second. Each spark, in addition to creating an ether pulse, charged the antenna and ground, and before the next spark came from the coil, the antenna and ground had plenty of time in which to set up an oscillatory discharge, similar to that from a Leyden jar (see page 1114). Each oscillation of this discharge created an ether wave, and since the successive oscillations were weaker, so were the resulting waves. That is, the waves were "damped," or weaker in amplitude (the meaning of "amplitude" is explained in Fig. 5), although they retained the frequency natural to the circuit which created them.

This type of wave was undesirable because it was "jumbled"—that is, it contained waves of varying length—and inventors were unable to devise tuning methods which would shut it out. To overcome this difficulty, modern systems use "continuous" waves, that is, waves of uniform amplitude. Such waves can be created by giving shocks to the antenna circuit so rapidly that it has no chance to interject its own oscillatory discharges between shocks. Various devices for doing this have been invented, notable among them being the Poulsen arc, the quenched spark gap, and high-frequency generators of alternating current. Some of these machines develop frequencies as high as 200,000 cycles a second. The newest method, however, uses the audion bulb, as explained later.

Since the pulses of a continuous wave train are too rapid to operate the diaphragm of a telephone receiver, some new device had to be invented to care for this difficulty. The modern method is the so-called "beat" reception. Turn to page 4033 and learn what "beats" are. Suppose now that our incoming waves have a frequency of 150,000. If we turn current induced by these waves into the receiving circuit, and at the same time, from a generator in the receiving station, we turn in a current with a frequency of 149,000, the two currents will combine to give 1,000 electrical "beats" a second. These "beat" pulses are slow enough to be heard in the receivers. As soon as the incoming waves stop, so do the beats, and the effects produced by the local current alone are inaudible.

From radio-telegraphy to radio-telephony was a long step. It took inventors years of experiment to overcome the two major difficulties which barred their way. The first was that the vibrations of ordinary sound have frequencies ranging between 30 and 4,000 a second (*audio* frequencies). Such slow rates are unable to set up ether waves, just as lowering a stone gently into water fails to set up a water wave. At least 50,000 shocks a second are required to create usable ether waves, and the frequencies used in radio range from this minimum up to 3,000,000 (*radio* frequencies). The second difficulty was the fact that sound is transmitted in the telephone by variations in the strength of the electric current, these variations corresponding to the variations of the sound waves. (*See* the illustration on page 3459.) To transmit these variations by radio it is obviously necessary to put out ether waves which can be varied in amplitude in a similar way.

But in the older radio systems the variations in wave amplitude were determined entirely by the rate at which the antenna oscillations died down, while the essence of the newer "continuous wave" system was that the amplitude of the waves did *not* vary.

The "Carrier Wave" in Radio-Telephony

Inventors racked their brains for years before they solved these problems by the so-called "carrier wave" method. The method works as follows: First a source of high-frequency current, either a generator or an oscillating audion, is set in operation in the transmitting station. This causes the transmitting antenna to give off continuous waves of uniform amplitude. Next, in the circuit which carries this current to the antenna circuit, is inserted a device which controls the *strength* of the current, but does not vary its period. The action of this device is controlled in turn by pulses from a telephone transmitter, so that the stronger the pulses from the transmitter, the greater will be the amplitude of outgoing waves. Thus the current pulses from the transmitter are "loaded," so to speak, upon the carrier, which is said to be "modulated." (Fig. 6.)

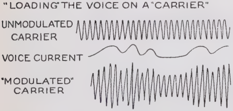


FIG. 6.—The basic principle of wireless telephony is the creation of a continuous carrier wave train and then so modulating it by means of the audion that its variations in strength correspond precisely to the variations caused by the voice in a telephone current. These variations in the carrier wave can then be heard in a telephone receiver as sound.

The only entirely suitable device for thus modulating the carrier wave is the audion. Since the audion is the fundamental feature of radio-telephony, you must understand its workings thoroughly. Read the article on page 257, look at the picture on page 3759, and study carefully Fig. 7, until you are familiar with every detail.

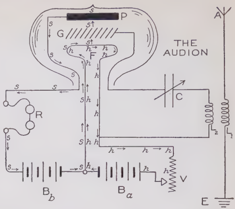


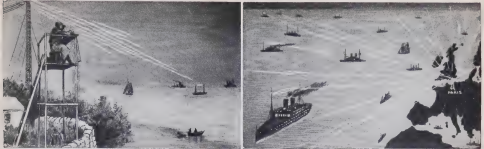
FIG. 7.—The hot-wire filament (F) in the audion bulb at the top is connected through circuit *h* to the storage battery B_a. Current flows continuously in this circuit, and keeps the wire red-hot, the variable resistance V permitting this heating current to be regulated. Plate P is in circuit *s* with the receivers R, the battery B_b, and the filament F. So long as the filament is cold, this circuit is broken by the gap between P and F. When heated, the red-hot filament "evaporates" negative electrons from itself, and these are attracted across the gap by the positive charge on P. Since the passage of negative electrons constitutes a current, heating the filament thus "closes" circuit *s*, permitting a steady current to flow. Now when an ether wave passes, it sends an impulse between antenna (A) and ground (E), through coil L_1. The induced current in coil L_2 charges the grid (G) and the filament (F). If the charge on the grid is positive, it adds to the attraction exercised by the plate, and an increased current flows in circuit *s*. If negative, the current is decreased. The audion "rectifies" alternating pulses into variable direct current, because the current in circuit *s* comes from a battery, and is affected in strength only, and not in direction, by alternating charges on the grid. The audion also amplifies, because a minute charge upon the grid is enough to produce a marked effect upon the current in circuit *s*. The variable condenser C is used to "tune" the set.

The essential action of the audion is that it passes a continuous current from filament to plate, and then impresses changes upon this current by means of charges upon the grid. All we need do, therefore, in order to modulate a carrier wave, is to lead the impulses which create the carrier wave through an audion from filament to plate, and then alter the strength of the impulses by leading the varying charges from the telephone transmitter to the grid. Once upon the grid, these charges will modulate the strength of the "carrier current," without affecting its period, and this modulated current then can be used to set up the desired oscillations in the antenna. In modern practice, an audion is also used to create the oscillations necessary to set up the carrier, by "hooking up" the audion as shown in Fig. 8. Thus a modern radio-telephone transmitting set has at least two audions—one, called the "oscillator," which creates the carrier pulse, and another, called the "modulator," which "loads" the voice pulses on the carrier.

Radio-Telephone Receivers

An ordinary radio-telegraph set can detect radio telephone messages, and many such sets are used, under the name of "crystal detector" sets, in regions close to broadcasting stations. They can do this because they have the ability to "envelop" incoming pulses. "Enveloping" is an action similar to what we should see if a gymnast had a punching bag attached top and bottom by elastic cords, and should strike it a number of rapid blows, making each blow a little

NEW SERVICES THAT RADIO PERFORMS AT SEA



In no field has radio found wider or more useful application than in navigation. It enables ships to keep in constant touch with the shore and with one another; it gives them time signals, as in the right-hand picture, which shows the time service of the Eiffel Tower station; and it has even been used to steer small craft from the shore, as in the picture at the left. "Radio lighthouses," which employ the methods explained in the picture on the following page, are now maintained at various points.

stronger than the one before. The net effect upon the bag would be a gradual movement outward, as though it were being pushed steadily instead of being struck successive blows. The blows "add together," as it were, to give the effect of a sustained push.

A telephone receiver acts much the same way when actuated by a series of current pulses which are increasing or decreasing gradually in strength. If, for example, such a series lasts for a thousandth of a second, the diaphragm moves as though one steady pulse, lasting a thousandth of a second, were acting upon it. That is, the diaphragm "envelopes" the pulses, as shown in Fig. 5, and thus can hear the variations in an incoming "modulated carrier." The crystal detector in such sets serves merely as a current rectifier.

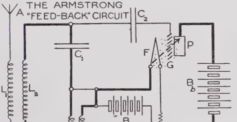


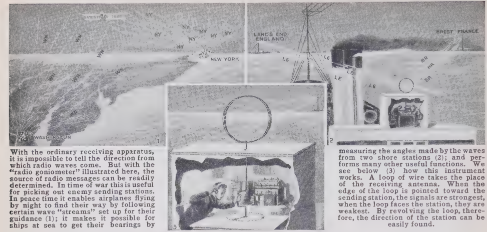
FIG. 8.—In this simple "feed-back" circuit, the heavy-wire portion to the right shows an audion "hook-up" similar to that in Fig. 7, except that it has an inductance (L_4), and a condenser "by-pass" (C_3) around the receivers (R), and different antenna connections. In this arrangement, when passing waves send pulses through inductance L_1, the current induced in L_2 circulates in the so-called "oscillating circuit" (shown by heavy wiring) through condenser C_1. Suppose this induced current is such as to send a negative charge through condenser C_2 to the grid, and a positive charge through the light wire to the filament. This decreases the current in the plate circuit. The decrease causes coil L_4 to act inductively on coil L_3, thereby affecting the charge placed upon the grid. If the circuits are adjusted properly in capacity and inductance, the charge will arrive on the grid in such a way as to *augment* the charge already there. This increases the effect on the plate circuit and thus the two circuits interact, or "feed back," through coils L_4 and L_3, to increase, or "regenerate," the original effect of the incoming pulse. The augmented effect gives loud signals in the receivers (R). By altering the electrical adjustments of the circuits, so that the "feed-back" effect arrives on the grid in time to *oppose* the charge already there, the plate circuit and the oscillating circuit will "fight each other," so to speak, and produce oscillating current in the oscillating circuit. This current may then be used in a transmitter or other device, by connecting the device in place of coil L_2. Sometimes unskilful adjustment in a regenerating set sets up this oscillation and causes the receivers to "howl." The condenser "by-pass" is needed because the inductance of the receiver coils would "choke down" the rapid current changes which must circulate in order to obtain the desired effect.

For receiving from distant stations, however, better results are obtained with sets which use the audion's power as an amplifier. The simplest hook-up for such a purpose is shown in Fig. 7, where the audion is used simply as a rectifier (or so-called "detector") and amplifier. From 1912 to 1915, E. H. Armstrong, in a series of interesting developments, brought out the "feed-back" circuit (Fig. 8). This circuit increases the audion's amplifying power tremendously, and is used in one form or other in most high-power modern receiving sets. The "feed-back" principle can be used to make the audion set up electrical oscillations for use either in creating carrier waves, or in "beat reception" of continuous wave telegraphy.

A typical modern receiving set also uses one or more audions as pure amplifiers, in addition to the bulb used as a combined detector or rectifier and amplifier. In order to use a second bulb as an amplifier, we merely connect the plate circuit of the first bulb so that it runs between filament and *grid* of the second bulb. This bulb then amplifies its own plate current to a strength greatly in excess of that possessed by the first plate current. If further amplification is desired, more bulbs are added. Transatlantic telegraph stations use a bank of seven bulbs "in cascade," as this arrangement is called.

Variations upon the devices and methods here described are countless, every week seeing new "hook-ups" and "circuits" brought out, but the same principles apply to any of them. "Super-regeneration," for example, is an ingenious development of the "feed-back" idea, while honeycomb coils, spider-web coils, and the like, are

DETERMINING DIRECTION BY RADIO



With the ordinary receiving apparatus, it is impossible to tell the direction from which radio waves come. But with the "radio goniometer" illustrated here, the source of radio messages can be readily determined. In time of war this is useful for picking out enemy sending stations. In peace time it enables airplanes flying by night to find their way by following certain wave "streams" set up for their guidance (1); it makes it possible for ships at sea to get their bearings by measuring the angles made by the waves from two shore stations (2); and performs many other useful functions. We see below (3) how this instrument works. A loop of wire takes the place of the receiving antenna. When the edge of the loop is pointed toward the sending station, the signals are strongest, when the loop faces the station, they are weakest. By revolving the loop, therefore, the direction of the station can be easily found.

simply inductive couplings of one sort or another. While many of these new circuits and devices are complicated in detail, their operation presents no difficulties which you cannot meet by applying the principles explained above.

If radio operators were asked what improvement they wanted most, probably all would say, "Abolish static!" "Static" is that condition of the ether which produces howling, hissing, grinding, or clicking sounds in the receiver, thereby preventing reception of messages. Its cause is still imperfectly known, but we can say this much: just as electron surges in a sending set create powerful disturbances in the ether, so do the immensely more powerful electron surges which constitute lightning. Every lightning flash sends a "radio message" surpassing in power any that can be emitted by the strongest station, and some of the static we hear consists of "messages" from lightning storms at various places around the earth.

Another serious problem has been interference, caused by the multiplication of sending stations. By 1927 there were more than 18,000 stations in the United States, and conditions were so chaotic that a federal commission was set up to regulate all radio communication. All operators were required to obtain licenses and to use only the wave-lengths and power assigned them.

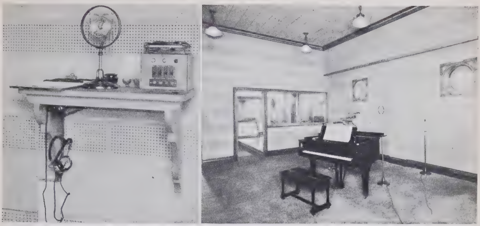
The importance of radio communication has increased year by year. Today all the great nations are linked with one another by stations capable of sending half way around the world. Most of these are high-powered stations using the longer wave-lengths, but a remarkable recent development has been the Marconi "beam" system. In this, the radio waves are focused by a reflecting network of wires which concentrates the electrical impulses into narrow beams as a searchlight concentrates beams of light. This permits the use of far less energy and shorter wave-lengths, and greatly increases the speed of transmission. In 1927 several beam wireless stations were put in operation, attaining speeds of 200 to 300 words a minute.

Transatlantic telephone service, which was experimentally accomplished in 1915, became a practical commercial reality in 1927. Since this process employs the long-wave system, the great problem was to obtain sufficient amplification. The relatively insignificant power of the human voice has to be magnified billions of times by giant vacuum tubes, involving problems of electrical engineering which took more than ten years of research to solve.

The year 1927 was also signalized by the first successful experiments in transmitting moving pictures by radio—"television." The process is essentially the same as for "telegraphing pictures," which is described on page 2783. Enormously greater speeds are necessary, however, since the average rate for transmitting a picture by wire or radio is from 10 to 20 minutes, while motion pictures require a speed of about 16 to the second. Beams of light passing through holes in a revolving disk scan the object to be transmitted at an incredible speed. This light, falling on a group of photoelectric cells, is changed into a varying electrical current, which is sent to the receiving station by wire or radio. There this varying current is changed back into flashes of light, and these build up a continuously moving image on a screen. The sending apparatus and the receiving apparatus are exactly synchronized, that is, kept moving in unison, so that 45,000 separate impulses a second will not become "scrambled."

The discovery of electric waves and their application to wireless communication is one of the most wonderful chapters of that great romance, modern science. Nearly 50 years ago, David Edward Hughes, the inventor of the microphone, found unexplained

WHERE SOME OF YOUR RADIO CONCERTS COME FROM



When you listen to programs from station W-G-N of Chicago, the performers will be standing in the studio to the right. Behind the piano is the control room, and beyond it is another studio. Sometimes both studios are used at once, and the tones are "blended," to get better quality. To the left is the announcer's stand, with switches to "cut in" his microphone or either studio. The queer material in the walls deadens all undesired sounds.

electric "impulses" in space, and actually used them to send wireless telephone signals for several hundred yards. But wise men thought him wrong. Professor Huxley and the president of the Royal Society in London both thought he was mistaken. It must have been a trick of his instruments, they said, that had misled him. And so the poor professor was discouraged and withheld the account of the experiments, and the wireless telegraph and telephone were kept back nearly half a generation.

The Discovery of Ether Waves

But with so many eager minds prying into the secrets of Nature, this discovery could not long be postponed. Several years before Hughes' experiments, a great British scientist, James Clerk Maxwell, had shown mathematically that it must be possible to have free electric waves in the ether similar to those of light. Some years later a brilliant young German, Heinrich Hertz, set out to test this theory. By 1887 he had devised and announced not merely a transmitter for sending out such waves into the ether, but also a crude "detector" for receiving them. The existence of electric waves in space was thus proved, and the name "Hertzian waves" perpetuates the memory of their discoverer.

Hertz was interested in these waves primarily as one more important thing to know about the universe. It was interesting to know that these waves traveled through space in numbers varying from 30,000 to 3,000,000 in a second, varying in length from 300 to 30,000 feet, and traveling with the speed of light at a thousand million feet a second; but he did not inquire what practical and commercial uses could be made of these silent movements in the invisible ether. We must however remember that without Maxwell and Hertz, there could have been no Marconi; without the discovery of electric waves and their laws, there could have been no wireless telephone and telegraph. To Marconi belongs the credit of showing how the Hertzian waves could be used on a large scale to send messages long distances.

The detailed story of Marconi's work is told elsewhere (*see* Marconi, Guglielmo). Here we may summarize his early achievements as follows: (1) using antennae to increase the power of his sets; (2) increasing the sensitiveness of the coherer, previously invented by Professor Edouard Branly, of Paris, and devising more efficient "detectors"; (3) contriving extremely high-power apparatus. We must credit him also with making radio a *commercial* as well as a technical success. This was important, because money for costly developments would not have been forthcoming unless radio had been proved profitable.

Other Names in the History of Radio

After Marconi, the men who have contributed important inventions are too many for mention here, with two exceptions—the men who invented and developed the audion valve. The basic idea of the audion was developed by Professor J. A. Fleming during the closing decades of the 19th century, and the grid feature was devised by Lee De Forest as told elsewhere (*see* Audion). This was the invention, more than any other since Marconi's work, which made possible the development of practical radio telephony, and immediately after its appearance it was being applied to this use by several workers. All armies engaged in the World War made notable improvements in radio, and after the war manufacturers of radio equipment began "broadcasting" concerts and news to develop a market for their wares. Various companies desiring publicity joined them, thus bringing radio as we know it in the home into being.

LOVELY WISCONSIN, *The* MEETING PLACE *of the* WATERS

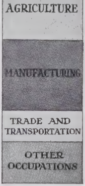
WISCONSIN. A green forest wilderness and a portage trail was the Wisconsin that Jean Nicolet found when, seeking distant China, he steered his birch-bark canoe into Green Bay in 1634. The Wisconsin of today, with its thousands on thousands of well-tilled farms and its scores of busy industrial towns, still has enough of the green forest left, especially in the beautiful northern lake region swarming with wild fish and fowl, to make an enchanting summer paradise for the jaded city dweller. Civilization and wilderness are neighbors.

Extent.—North to south, about 320 miles; east to west, about 300 miles. Area, excluding about 9,878 square miles of Great Lakes water surface within the state's jurisdiction, 56,066 square miles. Population (1920 census), 2,632,067.

Physical Features.—An undulating plain, rising to 1,940 feet above sea-level in north central portion (Rib Hill, near Wausau), and thence sloping to Lake Superior, the Mississippi River, and Lake Michigan; southern half diagonally intersected by a valley containing Green Bay, Lake Winnebago, and the lower Fox and lower Wisconsin rivers. Principal Rivers: Wisconsin, Fox, Chippewa, Black, and St. Croix. More than 2,000 lakes, mostly in glaciated north and east; Winnebago the largest.

Products.—Hay, corn, oats, potatoes, wheat, barley; butter, cheese, condensed milk; lumber, furniture, wood pulp, paper; leather, boots and shoes, men's clothing; foundry and machine-shop products, agricultural implements; meat products; flour and grist mill products; zinc, lead, iron ore, stone, and mineral waters.

Chief Cities.—Milwaukee (460,000), Racine (60,000); Kenosha, Superior, Madison (capital), Oshkosh, Green Bay, Sheboygan, La Crosse, Fond du Lac, Beloit, Eau Claire, Appleton, Wausau, Janesville, Ashland, Sturgeon Bay, Waukesha.



Chief Occupations

Wisconsin slopes into three main drainage basins. To the north it falls abruptly into Lake Superior; to the south and west it inclines gently, with a long slow slope, toward the Mississippi; to the south and southeast it drains by shorter slopes into Lake Michigan. Diagonally across the state from northeast to southwest runs a broad shallow valley, the water trough of Green Bay, the Fox River, Lake Winnebago, and the Wisconsin River.

The tradition that the mysterious Indian name Wisconsin means "meeting place of the waters" is, if not true, at any rate nicely invented; for here, in the Fox-Wisconsin valley, navigable waters flowing into the Mississippi are only a mile and a half from waters entering the Great Lakes. The main route of exploration and early trade was through this valley, with a portage across the narrow watershed at the point where the city of Portage now stands. This was also the favorite of the French among all the routes from the Great Lakes to the Mississippi, which made Wisconsin valuable to France, not merely as a highway of the fur trade, but even more as the link between the two halves of her western empire, Canada and Louisiana. The French and Indian names on the map of Wisconsin are almost the only remaining memorials to the two races that once used this valley route, now abandoned as a main highway of commerce but risen to new importance in industry. Eleven out of the state's 15 leading manufacturing towns lie in the southeastern triangle defined across the state by the Fox-Wisconsin valley, and more than 80 per cent of the manufactured products of the state come from this region.

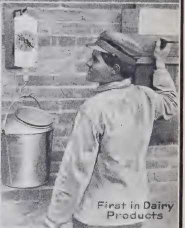
It is an ancient land, this Wisconsin, born when the world was young. Here and there pages of its history can be read in rocks so old as to make the Egyptian hieroglyphs seem as new as yesterday's newspapers. Here, for instance, is the granite backbone of the north-central part of Wisconsin, one of the first parts of the North American continent to emerge, a lofty mountainous island, from the primeval sea, while at its foot grew coral reefs to make the limestone foundations of the southern part of the state. Later we can read how nearly the whole of the state lay buried beneath the flooding glaciers of the Ice Age. And now the glaciers, after many a hesitating advance and retreat, have flung down their loads of earth and rock and gone forever, and we begin to see the features of the Wisconsin of today.

In the driftless area of the southwest, the drainage basin of the Mississippi, the deep wrinkles and rugged bluffs made by preglacial drainage and erosion still furrow the earth, but the ruggedness of all the rest of the state has been softened by a thin layer of fertile glacial drift which, it has been estimated, is worth $30,000,000 a year to Wisconsin

SOME REASONS WHY WISCONSIN KEEPS GROWING

A Rolling Land of Fertile Farms

Great Paper Mills and Wood-Working Plants

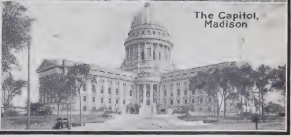

First in Dairy Products

Important Zinc Deposits

Leather Manufactur a Leading Industry

Makes Much Machinery

A Chief Source of Freshwater Fish


The Capitol, Madison

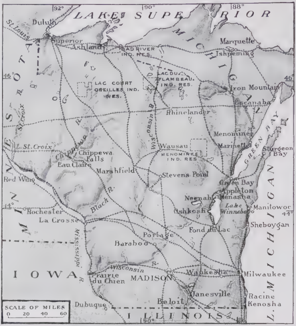
Wisconsin's fertile pastures are the homes of millions of cows, whose yield of milk makes it the first state in the Union in the production of butter, cheese, and condensed milk. With so many cattle, it is natural that leather should be an important product, and shoes and harness rank among the leading manufactures. Lumbering and the industries dependent on it, however, such as wood pulp and paper mills, are the greatest manufacturing group. Fish are taken chiefly from Lake Michigan, but also from Lake Superior, the Mississippi River, and from the many smaller lakes and streams visited every year by tourists and sportsmen.

farmers. The characteristic beauty and interest of the scenery of this part of Wisconsin is also due to glacial souvenirs—"drumlins" or oval glacial hills, bowlders, and the many lakes (more than 2,000), and "kettleholes" gouged out by the moving ice sheet. The beauty of these lakes has made them popular vacation resorts. The Four Lakes (Kegonoa, Waubesa, Monona, and Mendota) near Madison have been celebrated by Longfellow in verse:

Four limpid lakes—four Naiades
Or sylvan deities are these
In flowing robes of azure dressed;
Four lovely handmaids, that uphold
Their shining mirrors, rimmed with gold
To the fair city in the west.

The "dalles" or rapids and gorges of some of the streams flowing into the Mississippi are also remarkably beautiful, notably the Dalles of the St. Croix River near St. Croix Falls and the "Dells" of the Wisconsin River near Kilbourn City.

THE GEOGRAPHY OF THE "BADGER STATE"


92°
90°
88°
LAKE SUPERIOR
Duluth
St. Louis R.
Superior
Ashland
BAD RIVER IND. RES.
Marquette
Ishpeming
MINNESOTA
MICHIGAN
46°
LAC COURT OREILLES IND. RES.
LAC DU FLAMBEAU IND. RES.
Iron Mountain
Escanaba
Rhinelander
St. Croix R.
Wisconsin R.
Menominee
Marinette
Sturgeon Bay
GREEN BAY
L. St. Croix
Chippewa R.
Chippewa Falls
Eau Claire
Wausau
MENOMINEE IND. RES.
Marshfield
Stevens Point
Red Wing
Green Bay
Appleton
Neenah
Menasha
Black R.
44°
Rochester
La Crosse
Oshkosh
Lake Winnebago
Manitowoc
Sheboygan
Fond du Lac
Mississippi R.
Portage
Baraboo
Wisconsin R.
Rock R.
IOWA
Prairie du Chien
MADISON
Waukesha
Milwaukee
Janesville
Racine
Kenosha
LAKE MICHIGAN
SCALE OF MILES
0 20 40 60
Dubuque
Beloit
ILLINOIS

Most Wisconsin farmers (85 per cent) own the land they cultivate—a higher proportion than in any other state of the Mississippi valley. The leading crops are corn (the southern third of the state is in the great American corn belt), oats and potatoes (particularly in the center of the state), hay (the leading crop in the comparatively undeveloped north), wheat, barley, and rye. Other crops are flax, hemp, tobacco, sugar beets, and cranberries.

Much of Wisconsin's agricultural success is due to the state agricultural college, which is a part of the University of Wisconsin at Madison, the capital. It has worked out original methods in dairying, which have made Wisconsin the leading state of the Union in total value of dairy products. The Babcock test for butter fat in milk (*see* Dairying) and four other important dairy tests originated by the Wisconsin College of Agriculture are used all over the world. Its improved strains of barley, oats, and wheat have increased the state's grain crop by millions of dollars. Its improved methods of cranberry culture have increased the yield seven and eight times over.

In the early years of the 20th century Wisconsin was the leading lumber state of the Union, famous especially for its white pine, although it had already passed the peak of its lumber production. Much fine timber—birch, basswood, maple, oak, and hemlock—still remains in the north, but scarcely any white pine. In 1905 the state began to create a forest reserve, to be increased annually.

Though lacking coal and off the main lines of east-and-west continental travel, Wisconsin, largely by the use of water-power, has built up important manufactures, which have long since passed the point of being an outlet for domestic raw materials, and require importation. Leather manufactures, for instance, which rank high among the industries, were originally based on domestic hides and native hemlock, oak, and other tanning woods; now the chrome (the mineral chromium) used instead of the woods is imported from South America, and the hides come from all quarters of the globe. A chief factor in the state's manufacturing prominence is the cheap transportation afforded by the Great Lakes (*see* Great Lakes).

Another notable group among the state's manufactures consists of forest products—lumber, wood pulp and paper, and furniture. The state university and the United States forest service coöperate in maintaining a forest products laboratory. Among the other leading manufactures are foundry and machine-shop products, especially malleable iron, much of which is used in making agricultural implements, in which Wisconsin is a leading state. Some of the leather made in Wisconsin is worked up in the state into boots and shoes. Automobiles, meat products, printed matter, hosiery and knit goods, cars, copper, tin, and sheet iron products, and clothing are other noteworthy items on the long list of manufactured products. The Lake Michigan fisheries also contribute nearly a million dollars a year to the state's wealth, and the city of Green Bay is one of the leading fresh-

IN THE "DELLS" OF THE WISCONSIN RIVER

The "Dells," or more correctly Dalles (the word is French and means "slabs"), remind us that an ice sheet once covered a large part of North America. The ice dammed the Wisconsin River, and when the glacier retreated partially filled the old valley with débris, thus forcing the river to seek a new channel at the lowest point of drainage. In the course of centuries the stream cut a deep new bed in the sandstone. The weathering of the exposed rock and its varying resistance to erosion caused the irregularities which are characteristic of the steep banks.

water fishing centers of the world. But the pleasure fishing which attracts summer tourists by the thousands to the smaller lakes is many times more profitable to the state than the commercial fishing industry.

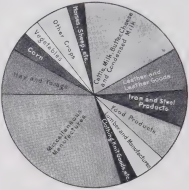
The character of its territory determined that Wisconsin should be predominantly a manufacturing and agricultural rather than a commercial and mining state. The seepage of underground waters through porous sandstones and limestones gives it an abundance of mineral springs and artesian wells, and in places there are deposits of metal-bearing ores. Lead mining was an important industry in the southwestern part of the state during late territorial days, but zinc is now the important mineral there. The lead and zinc usually do not contribute wealth equal to that from the iron output, which comes from the Penokee-Gogebic Range, in Wisconsin's portion of the Lake Superior ore districts. The state's other mineral products include the famous Montello and other monumental granites, as well as limestone, sandstone and granite for paving; sand, gravel, and clay for tiles and the cream-colored Milwaukee brick and red Menomonee brick. In the value of mineral water Wisconsin leads all the states of the Union, Waukesha being the chief production center.

About 80 per cent of the population are native born, but spring from a wide variety of stocks, largely German, especially in and around Milwaukee—partly a result of the exodus to escape political persecution after the unsuccessful revolution of 1848. There are also heavy sprinklings of Poles, Scandinavians, Bohemians, Belgians, Swiss, Dutch, Welsh, and Cornishmen.

Wisconsin is not a "pivotal" state, but its strongly marked political individuality is perhaps its most interesting feature. The "Wisconsin idea," to which volumes have been devoted, is hard to compress into a nutshell; but it is an attempt to make democracy more workable and efficient, and to reduce economic inequalities of opportunity. A direct primary law, the initiative and referendum (not the Oregon plan—in Wisconsin bills must pass the legislature before submission to the people), a public utilities commission, industrial insurance, and a long list of other industrial measures are among the means to the working out of the "Wisconsin idea." The Legislative Reference Department at Madison, founded by the late Charles McCarthy, is a mine of valuable information on problems of the day and on legislative procedure; it supplies members of the legislature not only with data but also with technical assistance in drafting bills. It was the first institution of its kind in the United States, though similar bodies have since been established in other states.

As democracy's special vice is commonly said to be neglect of expert counsel, it is interesting to note that the administration of much of Wisconsin's "radical" legislation is entrusted to expert commissions which are either highly paid or unpaid—never paid the mediocre salary which repels the specialist and attracts the ward-heeler. The University of Wisconsin, which President Eliot of Harvard called the leading state university, has had a large share in shaping the state's policy, being always ready to give information to the voter and to the legislator, and developing its contacts with the state through its emphasis on university extension.

Milwaukee is the chief industrial city, producing one-third of all the manufactures (*see* Milwaukee). Racine, the second manufacturing city, has one of the best harbors on Lake Michigan and carries on an extensive lumber and coal trade. It is the commercial and industrial center of a productive agricultural region, and its factories make automobiles, agricultural implements, malted milk, electrical devices, shoes, leather, foundry products, shirts, overalls, and many other products. Kenosha is also an important trade center; it manufactures leather, automobiles, furniture, wagons, machinery, etc. Superior shares with Duluth, Minn., one of the finest inland natural harbors in the world and the commercial advantage of being the extreme western port of the Great Lakes system. It has many manufactures, shipyards, immense coal docks, grain elevators, and a large dry-dock. Madison, the capital, is also an educational and manufacturing center and a summer resort. It is the seat of the University of Wisconsin and of a number of other educational institutions. Oshkosh, on beautiful Lake Winnebago, the largest lake in the state, is the seat of one of the largest state normal schools, and of factories for lumber and lumber products and a number of other important products. Green Bay is the oldest town in the state, and an important distributing as well as manufacturing center. Sheboygan is the shipping point for a farming and dairying region, with large cheese warehouses, many factories, large coal and salt docks, and important fishing interests. LaCrosse is the center of the farming and dairying region of western Wisconsin, southern Minnesota, and northeastern Iowa, with many important manufactures. Fond du Lac also is noted for dairy and agricultural products, and has a number of important manufactures. Beloit is the seat of Beloit College, of one of the largest woodworking machinery plants in the world, and other manufactures. Eau Claire is the commercial center of northwestern Wisconsin, and the outlet of the Chippewa lumber district. Appleton is the seat of Lawrence College and of extensive paper, pulp, farm implement, and other manufactures. Janesville is the tobacco center.



Relative Value of Wisconsin's Products

For centuries before the coming of the white man Wisconsin's beautiful woodlands, lakes, and rivers were favorite hunting-grounds and dwelling places for a large Indian population, as the many mounds and implements they left attest. Today the Indians number only about 10,000, confined almost entirely to reservations. The first white man to enter the region was probably Jean Nicolet, a French explorer sent out by Champlain. He landed near the present city of Green Bay in 1634 or 1635, and traversed the Fox River for a considerable distance. In 1658–59 two fur traders, Radisson and Groseillers, followed the Fox-Wisconsin route perhaps as far as the Mississippi. The first permanent mission was founded by Father Claude Allouez in 1665 near Ashland, and four years later the first church was built by him on the site of DePere, where a trading settlement soon sprang up. Other famous missionary explorers followed, including Marquette and Joliet in 1673, and LaSalle in 1679.

This French trading and missionary activity left marks of its influence in the French names of many towns and some of the old families of the state. At the close of the French and Indian War in 1763, the region passed under the rule of Great Britain. Although Wisconsin was part of the territory ceded to the United States at the close of the American Revolution, the British did not evacuate the military posts there until 1796, owing to the disputes between the countries which John Jay was sent to England to settle in 1794 (*see* Jay, John). Until 1822, when the opening of the lead diggings in the southwestern part brought a rush of immigrants, growth was slow and fur trading remained the chief occupation. Treaties with the Indians between 1829 and 1833 extinguished the Indian title to vast areas of land and opened it to settlement; but the Black Hawk War (1831–32) for a time retarded immigration. A steady tide of immigration then set in from New England, New York, and other eastern states.

Wisconsin was the last state created out of the old Northwest Territory. As originally planned it would have taken in a strip of land west of the southern end of Lake Michigan which now includes Chicago, but Congress paid no attention to the request of the inhabitants of this tract. Wisconsin Territory as formed in 1836 was much larger than the present state, for it included the whole of Iowa and Minnesota and parts of the Dakotas. When Michigan was admitted as a state, in 1837, the "northern peninsula," which geographically is a part of Wisconsin, was given to Michigan to compensate that commonwealth for the loss of territory to Ohio in what is called the "Toledo War" (*see* Ohio). Wisconsin received its present limits in the enabling act passed by Congress in 1847 to admit it as a state; but the first constitution framed under that act was rejected by the people because of its "radical" provisions relating to the rights of married women, the election of judges, etc. Next year a more conservative constitution was approved by the people and the state was admitted to the Union (1848). That same year the unsuccessful revolutionary movement in Germany drove thousands of German liberals across the Atlantic, a large proportion of whom made their new homes in Wisconsin. Anti-slavery sentiment flourished in the young state, and in 1854 Ripon was the scene of one of the earliest of the movements which resulted in the organization of the Republican party. Wisconsin played a noteworthy part in the Civil War, furnishing to the Union more than its quota of men and several commanders of distinction; one-ninth of the state's total population served in the Union

A GENERAL VIEW OF THE UNIVERSITY OF WISCONSIN

The university is beautifully located in a hilly section of Madison, overlooking Lake Mendota. The grounds cover about 1,000 acres. Although founded in 1838, the institution was not opened until 1851. Since 1885, when the number of students was only 500, it has grown rapidly, until now it is one of the largest institutions in the country.

army. In the Spanish-American and World wars its record was no less creditable.

Wisconsin's nickname, the "Badger State," has a curious origin. The name "badgers" was originally applied to the lead-miners near the Illinois line in early days, because they lived in dugouts on the hillsides similar to the burrows that badgers make underground. Afterward the name was applied to the people of the whole state.

WISTARIA. The large drooping clusters of handsome flowers which are borne in great profusion by the wistaria make it one of the most attractive vines used in the covering of verandas and walls. It grows rapidly, often 20 feet in a season. The leaf is formed of from 9 to 15 oval leaflets, the flower resembles the sweet pea in shape, and the seeds or beans are found in long pods. The wistaria is a native of Japan, China, and North America. There are several varieties, among which are the *Wistaria frutescens*, a species belonging to the United States, and the Chinese variety *Wistaria chinensis*, a more showy plant. The latter blooms earlier and has a looser cluster of pale lilac or white flowers; this is the most popular of the cultivated species of wistaria.

The wistaria was named after Caspar Wistar (1761–1818), a professor in the University of Pennsylvania, and was first spelled "wisteria." It belongs to the *Leguminosae* (bean family).

WITCHCRAFT. There is of course no such thing as witchcraft, and what really concerns us is the belief men used to have in the power of witches. The disappearance of that belief may rightly be called one of the evidences of the real progress of the human race. Witches were said to be women who made a contract with the devil, a contract sealed with blood, to serve him, and in return for that promise were given power by him to accomplish things beyond ordinary human abilities. They could bring sickness and death to whom they wished, they could go through locked doors, they could even ride through the air on broomsticks, and assume animal forms. Their greatest delight was to bring harm and suffering to those who incurred their spite. This they did in many ways, but often they made waxen images of those they sought to harm or kill and then pricked these images or melted them slowly over a fire, so causing wasting away, suffering, and finally death to the persons represented by the images.

According to these strange beliefs, there were great witch assemblies, known as "witch sabbaths," at which the witches met with the devil, performed elaborate and obscene ceremonies, and were instructed by him in the evil they should accomplish. It was believed that the devil left certain marks upon the persons of the witches, secret marks, which could be detected only by those expert in such things.

Most of the women suspected as witches were old ugly mumbling crones, without friends or influence, usually women who had incurred the ill will of neighbors in some way. Often the old crone had uttered foolish words of threat against someone who had made fun of her. The curious thing is that when such women were accused of having bewitched a cow or child or neighbor to death, they would often confess the deed, and add terrible details of guilt.

In all ages and all times there has been a belief among nearly all peoples in magic and evil spirits; the belief is to be found among the Egyptians, Chaldeans, and notably among the Hebrews. Nevertheless few people actually suffered on charges of witchcraft until the 15th century. Moses had commanded the children of Israel that they should not suffer a witch to live, but King Saul had consulted the Witch of Endor. The growth of a fixed theology, the effort to determine the provinces of the kingdom of the devil and to ascertain his position in the universe, led to a whole system of belief about witches. Certain elements of that system were brought into Christianity from Byzantine lore—as the "witches sabbath" and flying by night. By the 16th century the popes were urging the criminal prosecution of witches. But Catholics were no more to blame than the Protestants for such persecutions, if as much. Protestantism, with its emphasis on the authority of the Bible and its literal interpretation of the Scriptures, intensified the zeal against witches. All sects united in hunting down the agents of the evil one, but Calvinists were perhaps the most unrelenting leaders in that terrible search.

By the 17th century the people of Europe had been taught to look for witches and the courts put to death thousands in Germany and France, and a few hundred in England. In 1692 there was an outburst of witch persecution in Salem Village (now Danvers), Mass., which lasted eight months and in which 19 persons were hanged and one "pressed" to death. By the latter half of the 17th century the more intelligent people were beginning to suspect that witchcraft was a delusion. The new scientific movement and the growth of rationalism affected many people. Judges began to let witches go free. For another century the public made the way of the suspect woman a hard one, and she was often ducked in a pond, but the law was in her favor. John Wesley toward the close of the 18th century declared that to disbelieve in witchcraft was to disbelieve in the Bible. But his was the last voice of that kind. Today, however, in remote districts of both Europe and America, there are people who blame the diseases or losses of their cattle upon some neighbor woman whom they call a witch. But in general the world has ceased to believe in witches or to punish silly old women for imaginary crimes.

WITCH-HAZEL. A true witch of the woods, this shrubby little tree turns the year upside down by bursting into an abundance of bloom when other trees are shedding their foliage and when its own leaves are yellow and falling. Throughout the month of November the tiny yellow clustered blossoms wave on branches already laden with the seed-pods of last year's flowers. When the seeds are ripe these pods have a peculiar fashion of popping open with a sharp click and shooting the seeds to a distance of several feet.

The witch-hazel is found as a shrub in deep ravines, on shaded hillsides, and at the edge of woodlands from New England southward to Florida, and westward to eastern Minnesota. Only on the mountains of North and South Carolina and Tennessee does it attain the height of a tree. Its name probably comes from the fact that the forked twigs were supposed to have magic power in pointing out hidden springs. From the bark and leaves of the witch-hazel is distilled a liquid used in treating bruises and muscular soreness.

Scientific name, *Hamamelis virginiana*. Bark light brown, smooth. Wood light reddish brown, sapwood nearly white; heavy, hard, close grained. Leaves 4 to 6 inches long, alternate, simple, oval with notched edge; dark green above, paler underneath, in fall turning to yellow with rusty spots.

WOLF. Stories of encounters with wolves have been popular for hundreds of years, and it is a real disappointment to learn that few of them are true. Wolves are still very plentiful throughout the thinly settled parts of the United States, and they destroy thousands of sheep, cattle, horses, deer, and other animals every year. Only rarely, however, have they been known to attack man, and then only in packs.

The wolf is a carnivorous, or flesh-eating, mammal and formerly was found in all parts of North America, Europe, and Asia. They became scarce in the British Isles in the 16th century and were all killed off by the middle of the 18th century. There are no wolves in South America, Africa, or Australia. Wolves are said to be numerous in the steppes of eastern Russia, and these animals have always been described as being particularly ferocious, and when pressed by extreme hunger have been known to attack human beings.

The American wolves comprise two very distinct species. The larger is commonly called the gray wolf, or timber wolf; the smaller is the prairie wolf, or coyote. The prevailing color of both species is gray, tinged with yellow, but there are black timber wolves in Florida, and white ones in the far north. A large timber wolf stands 27 inches high at the shoulders, and is 66 inches long, including the tail which is 16 inches in length. The coyote is 20 inches high and 48 inches long; its tail measures 15 inches. In wooded regions east of the Great Plains, the coyote is often called the brush wolf.

Wolves hunt in packs. While some follow the trail of the game, others lie in wait to attack when the quarry approaches. Although they are destructive to larger game, their regular diet consists largely of rabbits, grouse, and the smaller rodents.

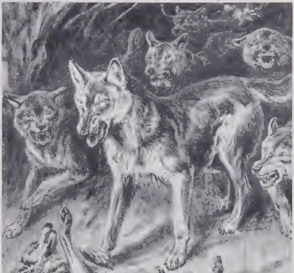
All wolves have powerful jaws, armed with 42 teeth. When angry or excited a wolf presents a truly terrifying appearance. The eyes flash like balls of fire; the lips are drawn back, disclosing the long, white, cruel-looking teeth; and the muscles become tense as if preparing for a spring. When cornered so it cannot escape it fights savagely and is a dangerous antagonist for a man without firearms. But its natural habits are cowardly and contemptible. There is nothing admirable about a wolf aside from its cunning, which is often surprising. Its ability to avoid traps, detect poison, and keep out of range of the hunter's rifle is remarkable.

Wolves are very prolific; their young, which are born in April or May, number from 5 to 13 in a litter. The young are blind at birth and are covered with soft brown fur. The breeding dens consist of shallow caves or hollow tree-trunks. The female does not permit the male to approach the den, for it happens not infrequently that the male kills and eats his own offspring. He has even been known to kill and eat his own mate. Wolves desert their young when in danger, and kill and devour their wounded and disabled companions.

Owing to the fact that wolves prey upon domestic animals and do immense damage to the Western stock-growing industry, bounties are offered in some states for their destruction. But the most valuable agency in the battle against the wolf is the federal Biological Survey, which has, in co-operation with the states, greatly reduced the loss of sheep and cattle.

Scientific name of timber wolf, *Canis occidentalis;* coyote, *Canis latrans:* European wolf, *Canis lupus.*

THE WOLF PACK GETS A NEW LEADER



Every band of timber wolves in the north has a leader, and the story goes that when the leader falters in the chase or misses his "kill," the snarling pack turns upon him and kills him. Here the artist shows us the fallen leader at the feet of his younger rival, who has just defeated him. In another instant the whole pack will be upon him.

WOLFE, JAMES (1727–1759). Slender, frail, and studious, James Wolfe, the conqueror of Quebec, was little like the usual ideal of a military hero. But his bright and piercing eye showed that the fire of energy and determination burned bright within; and when in 1759 William Pitt, prime minister of England, needed a commander to administer the finishing blow to the French power in America, he passed over the titled veterans who coveted the honor and entrusted Great Britain's destinies to this young and almost unknown soldier.

But Wolfe, though little known and not highly connected, had been long and thoroughly schooled in war. He had entered the army at 14, following in the footsteps of his distinguished father, Gen. Edward Wolfe. Skill and bravery won steady advancement for him, and at 31 he had been sent to North America with the rank of brigadier-general, to assist in the expedition against Louisburg, one of the strongholds of French power in the New World. His brigade effected a landing under heavy fire and played an important part in the memorable siege which resulted in the capture of that fortress (1758). Because of his skill and boldness, Wolfe was called the "hero of Louisburg"; and a few months later when Pitt resolved on the capture of Quebec, he gave young Wolfe the command of the expedition with the rank of major-general.

The taking of Quebec by Wolfe has been styled "one of the epics of modern military history." For three months he tried in vain to take the almost impregnable position of the French, who were entrenched below the town. At last, depressed by his many failures and enfeebled by internal disease, Wolfe embarked on the bold exploit which made his name forever glorious. He crossed the river above the town, in the early morning hours of September 13, surprised the French sentinels at the cove which now bears his name, climbed the steep heights, and by daybreak had 4,000 men drawn up in battle array on the Plains of Abraham. As he led his men in the battle that followed, General Wolfe was wounded three times, and died before the pursuit was ended (*see* French and Indian War; Quebec).

WOLSEY (*wol'sĭ*), CARDINAL THOMAS (1475?–1530). "The proudest prelate that ever breathed," as Cardinal Wolsey has been called, shaped England's policy abroad and was the leading figure in church and state at home for more than a decade during the early years of Henry VIII. His foes contemptuously referred to him as "a butcher's son," for he was the son of a wealthy citizen of Ipswich who sold meat as well as other commodities. Young Thomas was sent to the University of Oxford, where he took his degree at the age of 15. After becoming a priest, he was appointed chaplain to Henry VIII. His extraordinary powers won for him rapid advancement, and soon he was Henry's principal minister. He was made chancellor of the kingdom and archbishop of York, and Henry secured from the pope his appointment as cardinal, and the pope's legate or representative in England.

Soon all authority was concentrated in the hands of the great cardinal. He made peace and war. England was too narrow a field for his vast ambition; he aspired to be the arbiter of Europe. He threw England's influence into the scale on the side of the Emperor Charles V in the latter's rivalry with Francis I of France, expecting thereby to enlist the emperor's aid for his own aspirations to the papacy.

The costly splendor of his palaces, his gold and silver plate, and his New Year's gifts outshone those of kings. His servants knelt to wait on him; bishops tied his shoe-latchets; dukes held the basin while he washed his hands. Ambassadors might consider themselves honored in being permitted to kiss his hand, but might not, on pain of the cardinal's displeasure, presume to discuss new business with the king before broaching it to Wolsey.

Prodigiously able, indefatigably industrious, he ruled with a firm hand, doing swift unsparing justice, ruthlessly sweeping away feudal jurisdictions, and initiating that policy of dissolution of monasteries which was to be carried through to completion by his royal master King Henry VIII. Some of the confiscated religious property he applied to the foundation of Christ Church College at Oxford University. But his greed, his arrogance, and his insatiable lust for power outweighed his many great qualities, and the sumptuous edifice of his grandeur was built on sand. His more than regal state was sustained, not by the revenues of his many offices alone, but also by what today would be considered corruption—enormous pensions from foreign sovereigns, bribes from English suitors for justice, and the misappropriated revenues of the suppressed religious foundations. His policies and his haughtiness alienated churchmen and laymen alike. Charles V had judged it prudent to see that the intractable Wolsey should not become pope. His power had no more stable base than the favor—which for 20 years, to be sure, had seemed as solid as the hills—of the careless, pleasure-loving king.

But Henry VIII was developing a taste for the substance of that power so long monopolized by the mighty chancellor. The costliness of Wolsey's showy foreign policy was added to other grounds for popular murmurings against him. When, having made himself responsible for the success of Henry's appeal to Rome for a divorce from Catherine of Aragon, the cardinal committed the unpardonable crime of failure, his doom was sealed. The king's rage, overflowing all bounds, in a moment swept away every one of Wolsey's civil offices and preferments. His retirement to his archbishopric of York—which he had never before visited—did not place him beyond the reach of the king's unsated anger. Summoned to London to answer to a charge of treason, he died on the way, crying out—so says tradition—"Had I but served my God as faithfully as I have served my king, He would not have given me over in my gray hairs."

WOLVERINE. A notorious glutton and pest and a remarkably cunning thief, the wolverine has no friends. The trapper especially hates it, for again and again it steals his bait and his capture, and sometimes even carries off trap and all. It will raid cabin and camp, destroying in wholesale fashion, seemingly from pure malice. Because of its strength and cunning, both Indians and Eskimos look upon this animal with a sort of awe and make offerings to propitiate its evil spirit. The Eskimos wear a bit of wolverine fur in order that they may acquire some of its power.

THE WOLVERINE, WHO HAS NO FRIENDS

The Wolverine is the largest of the American fur-bearing animals of the family *Mustelidae*, to which the weasels, otters, badgers, and skunks belong. It is a notorious glutton and a remarkably cunning thief.

The wolverine is a member of the weasel (*Mustelidae*) family. It inhabits the northern forests of Europe, Asia, and America. The American wolverine is about the size of a bulldog, and has a body and paws similar to those of a bear. It is probably the most powerful animal for its size in existence. The body is covered with shaggy hair of a blackish color, with pale bands along the sides and one on the forehead. It feeds on squirrels, hares, foxes, grouse, and other animals. The glutton, as the Old World species is called, is similar in appearance and habits.

Michigan is called the Wolverine State because in early days the wolverine abounded in its forests. The animal is found in the northern Cascades, and in the Rockies as far south as Great Salt Lake, although it is becoming quite rare. It occurs in greater numbers in arctic America, abounding in portions of Alaska. Despite its bearlike structure, the wolverine is unable to climb trees. It dwells in underground dens. Scientific name, *Gulo luscus.*

WOMAN'S CHRISTIAN TEMPERANCE UNION. This society, one of the world's largest organizations composed exclusively of women, has waged unremitting battle against the liquor traffic for half a century. It grew out of the Women's Crusade, started in 1873 by the women of Hillsboro and Washington Court House, Ohio, to fight the saloons. Then came the Woman's Christian Temperance Union, organized in Cleveland, Ohio, in 1874, at a meeting to which women came from 16 states. In 1883 the "W.C.T.U." as it is popularly known, was incorporated. It now has branches in every state, territory, and dependency of the United States, with local branches in about 20,000 cities and towns. All members must sign the total abstinence pledge and pay annual dues. The white ribbon is the Union badge.

The W.C.T.U. has a Young People's Branch and a Loyal Temperance Legion for the younger members and a number of separate state groups among the colored race. The program of work, besides temperance, includes Americanization, work for women in industry, child welfare, and other betterment efforts, under the direction of some thirty departments. Temperance education in the schools is directly the result of efforts by this organization.

The headquarters of the national W.C.T.U. are at Evanston, Ill., under the same roof with the former home of Frances E. Willard. In addition it owns in that city a large brick building that houses the editorial rooms, publicity bureau, and business offices of the Union. Besides its campaign and department literature the W.C.T.U. publishes its weekly official organ, *The Union Signal*, and also *The Young Crusader*, a monthly paper for children.

The World's Woman's Christian Temperance Union was founded in 1883 by Frances E. Willard. To this international organization the women's temperance societies of over fifty other nations belong, making a total membership of over half a million members devoted to this cause.

WOMEN'S CLUBS. In the World War, as in every important movement for good in the past 50 years of United States history, a very influential part was played by the clubs and other organizations of active and patriotic women. In the United States women's clubs date from 1868, when two clubs started at practically the same time—the Sorosis in New York, with Jennie C. Croly ("Jennie June") as president; the other, the New England Woman's Club, under the leadership of Julia Ward Howe.

We can roughly divide women's clubs into the two groups of those that have the social or cultural aims of members as their object, and those working for civic betterment and the making of better laws, especially for women and children. Naturally many clubs combine social, cultural, and philanthropic aims. In all there are about ten thousand women's clubs in the United States. In 1889, when women's clubs had spread all over the Union, Sorosis called a convention with the idea of organizing a general federation and 21 clubs sent delegates. The next year a general federation was formed. Two years later Maine organized a state federation, and since then every state, including Alaska and the District of Columbia, has like groups. The General Federation of Women's Clubs meets every second year and its membership includes individual clubs as well as state and local federations. Affiliated with the General Federation are other groups, such as the National Kindergarten Association, the International Sunshine Society, and similar organizations of other lands. The work of the General Federation is carried on through departments, patterned much on the same plan as that of any large woman's club.

Too much cannot be said for the work accomplished by these clubs. Besides their great cultural value to their own members, they have founded and maintained thousands of public and traveling libraries, kindergartens, scholarship funds for ambitious students, and traveling exhibits of art and of household art and appliances; they have equipped and opened many playgrounds and parks, and have done valuable civic work along many other lines. In many instances the women have financed promising experiments in education or civic work until the experiments had opportunity to prove themselves worthy of public support, which they could not have done without this private help. But the greatest service the women's clubs have rendered is, perhaps, the education of public opinion along the lines of child welfare, improved legislation, social hygiene, public health, and other agencies of higher and better civilization.

WOMEN'S RIGHTS. Woman's progress has been a gradual one, becoming more marked as both men and women learned that one could not advance far without the other. Most uncivilized races hold women inferior to men, but as civilization progresses it is recognized that all the people, men and women alike, must be fitted to bear a share in the nation's support and betterment.

Under certain systems of ancient law, traces of which have survived into modern times, a woman, no matter how old, was theoretically a perpetual minor—always subject to control by father, husband, or some male guardian. Her actual status often was much better than her theoretical legal position; but the legal inferiority was a practical handicap and represented, moreover, a general conviction that sex differences must be reinforced by artificial distinctions in privileges and rights. So old-fashioned propriety has usually shaken its head in shocked protest when women demanded new privileges—higher or professional education, the privilege of earning their own living outside the home, of competing in factories, business, or the professions on an equal basis with men, the right to control their own property, and, most important of all, a voice in making the laws which control their own well-being and that of their homes and children.

The women's rights movement is a wise one. Many of the pioneers worked for certain specific reforms alone, as for broader educational or professional opportunities. The later movement has focused on the demand for suffrage, in the conviction that other improvements in the condition of women would follow the attainment of the vote.

Margaret Brent, heir and executrix of Gov. Leonard Calvert of Maryland (brother of Lord Baltimore), is believed to have been the first tax-paying woman in America to ask political representation. She demanded "place and voice" in the Maryland legislature in 1647, and her plea was refused only after hot debate. Tax-paying widows and "spinsters" (unmarried women) voted later in some of the colonies—New Jersey, for instance; and women sometimes attended New England town meetings, either on their own account or as representing their husbands.

In France, Olympe de Gouges in 1789 published a 'Declaration of the Rights of Woman' as a protest against the omission of any mention of women from the Revolutionists' 'Declaration of the Rights of Man'. A petition for woman suffrage presented to the French National Assembly in the same year was refused. The Code Napoleon or code of laws promulgated under Napoleon deprived French women of many rights they had formerly enjoyed.

An Englishwoman, Mary Wollstonecraft, inspired by the French Revolution and Olympe de Gouges' protest, in 1792 published 'A Vindication of the Rights of Women', which has remained a landmark in the women's rights movement. Seventy-seven years later the English political philosopher John Stuart Mill (1806–73) published an even more notable contribution in his essay entitled 'On the Subjection of Women'.

Beginnings in the United States

The organized women's rights movement began in the United States in 1848, as a direct outgrowth of the anti-slavery struggle. In 1840 several women delegates, among whom was the Quakeress Lucretia Mott (1793–1880), were sent to a World's Anti-Slavery Convention in London, but were not allowed to take their seats. Lucretia Mott and Elizabeth Cady Stanton (1815–1902) thereupon resolved to hold a women's rights convention on their return to America; and eight years later it was held at Seneca Falls, N.Y. Although the movement received aid from broad-minded men like William Lloyd Garrison, Wendell Phillips, Henry Ward Beecher, and Ralph Waldo Emerson, the women pioneers, prominent among whom were Susan B. Anthony (*see* Anthony, Susan B.), Lucy Stone (1818–1893), and Julia Ward Howe (1819–1910), faced ridicule for many years.

In 1869 women from 19 states met in New York and formed a National Woman Suffrage Association, headed by Elizabeth Cady Stanton and Susan B. Anthony, to work for an amendment to the Federal Constitution enfranchising women. Later in the same year was formed the American Woman Suffrage Association, headed by Henry Ward Beecher and Lucy Stone, working to obtain suffrage chiefly through amendments to the state constitutions. The two bodies united in 1890 to form a National American Woman Suffrage Association, which thereafter pursued both methods.

For 50 years representatives of the National Association had hearings before the committees of every Congress, but the campaign in the states was the first to show results. The first territorial legislature of Wyoming, in 1869, gave women the vote; the territory of Utah did the same thing next year; and both states came into the Union (in 1890 and 1896, respectively) with woman suffrage clauses in their constitutions. Colorado had granted woman suffrage in 1893; Idaho enfranchised women in 1896. One by one, other states fell in line, until by the end of 1919 the women of 30 states had the right to vote for presidential electors.

Constitutional Amendment

A woman suffrage amendment to the Federal Constitution had been presented to every Congress since 1878. Previous to 1914 it had never been discussed in the House, only once in the Senate, and usually it had not been reported out of committee. By 1917 its ultimate passage was recognized as inevitable. In 1918 and again in 1919 it passed the House and just failed of passage in the Senate. In May 1919 it was passed at a special session of the newly elected Congress. Illinois was the first state to ratify the amendment. Ratifications were obtained from the necessary three-fourths of the states, and as the Nineteenth Amendment to the Federal Constitution it was proclaimed Aug. 26, 1920, so that women citizens throughout the United States were enabled to vote at the presidential elections in November of that year. The amendment, as now enacted, reads:

> The right of citizens of the United States to vote shall not be denied or abridged by the United States or by any state on account of sex.
>
> Congress shall have power to enforce this article by appropriate legislation.

Meanwhile new leaders had been growing up in the movement to take the place of those dropped out because of advancing years. Mrs. Stanton had resigned the presidency of the National Association in 1892, at the age of 77; Miss Anthony, her successor, had resigned in 1900 at the age of 80, to be succeeded by Mrs. Carrie Chapman Catt, who was president continuously thenceforward except for the eleven years between 1904–15, when Dr. Anna Howard Shaw (1847–1919) was president. Mrs. Rachel Foster Avery, corresponding secretary for 21 years, Mrs. Harriet Taylor Upton, national treasurer for 17 years, and Miss Alice Stone Blackwell, recording secretary for 20 years, were among the other women who saw in the final victory of the woman suffrage amendment the crown of long laborious years. In 1920, its object attained, the National Association passed out of existence, its place being taken by the National League of Women Voters.

In 1913 a feeling of dissatisfaction with the conservative methods of the National Association had resulted in the formation of the Congressional Union, led by Miss Alice Paul, which copied the methods of the British militant suffragettes, picketing the White House, publicly burning President Wilson's speeches, and "heckling" speakers. In 1917 this movement became the National Woman's Party.

In Great Britain a similar division of sentiment had existed between the National Union of Women's Suffrage Societies, which followed conservative methods and the National Women's Social and Political Union, the organ of the "militant suffragettes," headed by Mrs. Emmeline Pankhurst and her daughters Christabel and Sylvia Pankhurst. Believing that "political rights are never granted save in response to irresistible pressure," these women adopted the policy of doing whatever in their belief would either embarrass the government or call attention to their cause. When the World War broke out in 1914 the militants declared a truce and the suffrage leaders of both parties generally devoted themselves to the service of the government. By that time many of the most powerful opponents of woman suffrage, including the prime minister Mr. Asquith, had come to regard it as inevitable, and its grant was now urged as a fitting recompense for women's war services. A bill conferring the suffrage on women over 30 was reported in 1917 and passed in 1918. As Great Britain has no written constitution, nothing further was necessary to put into operation this reform which added 6,000,000 voters to the electorate.

Gains in the British Colonies

Several British colonies and many European countries had previously given women full or partial suffrage. New Zealand was the first country in the world to grant women complete suffrage (1893). The Commonwealth of Australia gave national suffrage in 1902; the several Australian colonies conferred state suffrage on their respective women citizens, some before and some after the grant of the Commonwealth suffrage. The Dominion of Canada gave national suffrage in 1918; all the Canadian provinces except Quebec and Prince Edward Island had by that time granted full suffrage—Manitoba, Alberta, Saskatchewan, and British Columbia in 1916, Ontario in 1917, and Nova Scotia and New Brunswick in 1918; the Territory of the Yukon followed in 1919.

The modern movement toward equal political privileges began on the continent of Europe with Sweden's grant in 1862 to women taxpayers (widows and spinsters) of a vote for all officials except members of parliament. The first European country to give women full suffrage was Finland (1906), Norway following in 1907. The World War gave tremendous impetus to the movement, by its social and political upheavals and by laying new responsibilities on women. Among the countries that have granted women full suffrage are Iceland (1914), Denmark (1916), Russia (1917), Germany (1919), Sweden (1919), the Netherlands (1919), Lithuania, Czecho-Slovakia, Poland, Latvia, Esthonia, Luxemburg, and the Irish Free State. Belgium, Italy, Hungary, and Spain are among the countries that have given women partial suffrage. France and Switzerland are the only considerable European nations which do not have woman suffrage in any form.

Even in conservative Asia the movement is spreading. Women vote in one of the provinces of China, and in Burma, Bombay, Madras, Bengal, and several other provinces of India.

The International Woman Suffrage Alliance was formed in 1904. In the same year the International Council of Women made the promotion of woman suffrage a part of its work. These two great organizations have steadily lent aid in various countries to the efforts made by women as yet unenfranchised.

The right to hold office has sometimes followed and sometimes preceded the grant of the suffrage. In various American states women have long been eligible to certain offices, particularly those connected with education; and in a few states the office of state superintendent of education has been customarily filled by a woman. One of the most notable educators who have filled the office of city superintendent of schools in the United States was Mrs. Ella Flagg Young, superintendent of Chicago schools 1909–15. The first woman elected to the United States Congress, Miss Jeannette Rankin, took her seat as representative at large of the suffrage state of Montana in 1917, three years before suffrage was extended to all women citizens of the United States. Women senators and representatives have been elected to various state legislatures, and also to some of the Canadian provincial legislatures. Women are now eligible to all civil offices in the United States. The first woman to take a seat in the British Parliament (1919) was Lady Astor, the American-born wife of Viscount Astor. Women delegates have played a significant part in the conventions of all political parties in the United States since 1920. Women have held various city offices, from mayor down, in the United States and in Great Britain. In the latter country they were made eligible to hold the offices of mayor, alderman, and county and town councilor in 1907. In the United States, in certain instances, an entire municipal ticket composed of women has been elected, generally by the votes of both men and women, who believed this to be the best way out of the grip of machine politics.

In the national and state elections of 1924, more than 125 women were elected to important offices. Chief of these were the first two women governors in United States history—Mrs. Nellie T. Ross of Wyoming and Mrs. Miriam A. Ferguson of Texas.

WOODCOCK. The woodcock is also known as the "gig-headed snipe," for it belongs to the snipe family. It is about 11 inches long, and is feathered in variegated brown, gray, and black. Its most noticeable feature is its very long bill, with which it extracts worms from the soft ground of the swamp. The woodcock usually spends the day in some shadowy retreat, flying to a favorite resort for its evening meal. It is an excellent game bird.

During the mating season, the male gives a regular twilight exhibition. Soon after sunset he may be seen above the marsh, whirling in spirals to a height of 50 or 60 feet, then he circles horizontally and, as he descends, utters his cheeping cry. Upon reaching the ground, with dragging wings he struts like a tiny turkey-gobbler. Sometimes he repeats this performance for more than an hour at a time.

Woodcocks nest on the swampy ground, the nest containing three or four olive-gray eggs streaked with brown and black. They breed from the northern half of the United States to Alaska and winter in the southern states and through Central America and Brazil. The European woodcock is slightly larger than the American species. Scientific name, *Philohela minor*.

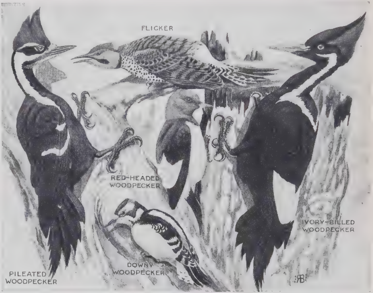
WOODPECKER. The woodpecker is a knocker! But he indulges in this practice to good purpose. He goes up and down the side of a tree with a *rap, rap* of his stout beak against the bark, and when his keen ears detect the sound of an insect within, he drills rapidly with his chisel-pointed hammer, until his long tongue can reach and bring forth the victim. The larvae of moths and beetles make up a large part of the woodpecker's food. When a pair of woodpeckers want a home, their picklike bills and strong neck muscles enable them to make a deep hole in some decaying tree or post, and on the chips that fall to the bottom of this hole Mrs. Woodpecker lays her glossy white eggs and rears the young.

Members of the woodpecker family (*Picidae*) are characterized by short stout legs and toes, sharp claws, and stiff tail feathers, terminating in sharp spines which can be pressed against the bark to help support the bird in an upright position while it works. The most peculiar point in the anatomy of these birds is the tongue. This is cylindrical and at the front end terminates in a hard point, with barbs upon the sides. It can be thrown out to great length and it is a most effective instrument for dislodging ants and grubs from their bark burrows.

Woodpeckers are found in all wooded portions of the world except on the island of Madagascar and in the Australian region. As a family they are less migratory than most other birds and the majority of the species occupy the same range throughout the year. Most of these birds have a wavy galloping flight. Though they do not sing, they have distinctive and in some cases musical calls. The drumming sound, which is their common mating call, is made by the extremely rapid hammering of the bill on a hollow tree or, in towns, often on house roofs or water-spouts.

Woodpeckers usually have a plumage of barred or spotted black and white, or brown and black, marked about the head with red or yellow. In size they range from the ivory-billed woodpecker, 21 inches long, to the downy woodpecker, $6\frac{1}{2}$ inches long. They are mostly tree-dwelling birds, only the flicker feeding on insects, especially ants, found on the ground. (For illustration in color of the downy woodpecker and the flicker, *see* Birds.)

COMMON BIRDS OF THE WOODPECKER FAMILY

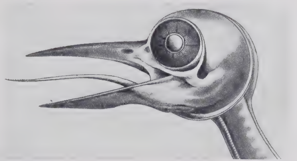


Probably the best known of these is the Red-Headed Woodpecker, whose red head and black-and-white body are familiar in most parts of North America. The Downy-Headed Woodpecker gets his name from the fluffy feathers of his head, and the Flicker from the curious cry he emits. The Flicker's back is olive-brown barred with black, and the rump and upper tail feathers are pure white; the wings and tail on the under-side are yellow, from which it is sometimes called the Yellowhammer or the Golden-Winged. The Ivory-Billed Woodpecker and the Pileated Woodpecker are the largest and scarcest members of the family.

The woodpeckers are a much maligned family, for they rarely disfigure a healthy tree and every year they destroy countless millions of harmful insects.

The only exceptions are the sapsuckers, the best known of which is the yellow-bellied sapsucker of eastern North America. In the spring these birds bore many holes through the bark of sap trees, so they can sweep in the sap with their brushlike tongues. Trees so attacked often die. The red-breasted sapsucker of California also does considerable damage.

HOW THE WOODPECKER PECKS



Nature has provided the Woodpecker with a beak and a tongue admirably adapted to their work, as you see in this drawing showing the structure of a typical woodpecker's head. The beak is very powerful, with an extremely hard tip, which the bird uses like a pick-ax to dig holes in the trunks and branches of trees. The tongue can be extended far beyond the beak, and its horny tip, covered with tooth-like filaments, scrapes up the food. The tongue easily removes insects and larvae from the holes bored by the beak.

The ivory-billed woodpecker is the most magnificent of North American woodpeckers. It is black, with white on the shoulders and wings, and the males have a scarlet crest. It is a southern bird, only occasionally found as far north as Illinois. The pileated woodpecker is next in size, sometimes 19 inches in length. Its plumage is rusty black with a showy scarlet crest. It is very wild and rare. The red-headed woodpecker is very abundant through most of the United States east of the Rocky Mountains. Its head is red, back black with white patches, and under parts white. This well-known bird adds grasshoppers and flies to the regulation woodpecker diet. Its rain-call is familiar to all who know the bird but this is only one of its many calls, for it is the noisy member of the group.

Scientific name of ivory-billed woodpecker, *Campephilus principalis;* of pileated woodpecker, *Phloeotomus pileatus;* of red-headed woodpecker, *Melanerpes erythrocephalus;* of downy-headed woodpecker, *Dryobates pubescens;* of flicker, *Colaptes auratus luteus.*

WOOD-WIND INSTRUMENTS. The most primitive of wood-wind instruments is the fife or flute, from which developed in early Greek times the Pipes of Pan, or syrinx, a bundle of hollow reeds fastened together so that the performer could play a melody by blowing across the top of first one, then another. Flutes made of the hollow leg-bones of birds have been found among the relics of the ancient cave dwellers. The breath of the player, blown across a hole drilled into the side of the bone, caused the air in the hollow tube of the bone to vibrate and produce a tone, just as in the flute of today.

Most modern flutes are made of carefully finished wood. Some are made of silver, and others have even been made of carved ivory, but the tone of the wooden instrument is preferable. The flute is furnished with a set of keys which make it possible to produce all the tones of any scale. It has a voice so acute that a melody played on a flute can be heard above all the other instruments of a full orchestra. The smallest type of flute, the piccolo, sounds the shrillest notes of the orchestra. The fife, which resembles the flute except that it has six finger-holes instead of keys, is used chiefly in military music.

Other instruments in the wood-wind group are the oboe, English horn, clarinet, and bassoon. These differ from the flute in that they all have single or double reeds fitted into the mouthpiece. The oboe is larger than the flute and has a double reed in its mouthpiece. Unlike the flute, it is played from the end and is slightly conical in shape. Its tone is somewhat like that of the violin, but shriller and more penetrating. It is often used for plaintive and rustic effects. The English horn is a larger oboe, with the upper part bent. Its tone is rich and beautiful, and is especially effective in mournful passages. The bassoon, the bass of the oboe, is sometimes called the clown of the orchestra because when its deep tones are produced with extreme agility they are irresistibly grotesque. In ordinary use it supplies the bass of the entire wood-wind group. It is so long that its tube has to be bent back upon itself, bringing what we would naturally call the lower end to a position above the mouthpiece. The double reed is fixed to a crooked mouthpiece several inches in length coming from the side of the instrument.

The clarinet is larger than the oboe, and its tube is straight, not conical. Its mouthpiece is cut into almost the shape of a chisel, and has a single thin flat reed. Its voice has three distinct qualities, the lower tones being dark and gloomy, the middle tones full and liquid like a soprano voice, and the highest fierce and shrill. In fullness and variety of tone it is the chief of wind instruments, and hence is the leading instrument in military bands. The bass clarinet is a much larger and deeper-toned instrument. The top is bent to accommodate the player, and the lower end is bent back upon the body and has a decided flare, or bell.

In general, the wood-wind instruments have a softer tone than the metal horns, or "brasses" as they are called. The tones best described as "blare" are absent, being replaced by more plaintive overtones. For this reason they blend better with stringed instruments. (*See* Musical Instruments; Orchestra.)

How the SHEEP'S COAT GETS on YOUR BACK

A Great Wool Storehouse where Fleeces are Sorted and Graded

WOOL. Because it effectively keeps in the heat of the body, woolen garb is the most comfortable in northern climes, and wool has become the characteristic clothing of the Western World, as cotton is of the warmer East. Since the introduction of machinery the use of wool in the United States has increased from three to six pounds for each person—a little less than the average annual "clip" from one sheep. And even this would not be nearly enough to go around if much of the pure wool were not mixed with cotton, and if the supply of new wool were not supplemented by the used wool gathered by armies of "old clothes men" and ragpickers the world over.

The presence of cotton in woolen cloth is not always a disadvantage, since it is useful in strengthening cheap and tender woolens. Such mixed material is, however, sometimes sold as "all wool," and it is difficult for the customer to detect the adulteration. One of the easiest tests is to bite a single thread. Wool is harsh and tough between the teeth, while cotton is soft and crushes. The fibers may also be distinguished by unraveling a piece of the warp and filling threads, being sure to untwist all double ones, and then burning each thread separately. If it chars and swells, gives forth a greasy odor, and refuses to carry the flame, it is wool; but if it burns without a greasy odor and carries the flame freely, it is cotton. Sometimes, however, the fibers have been blended before spinning, and a more elaborate test must be used. Boil a sample in a strong caustic soda solution; the wool will dissolve, but the cotton will remain.

The presence of "shoddy"—remanufactured material—is more difficult to detect. Shoddy fabrics may be all wool, but the reclaimed fibers are shorter and weaker and will not wear so well. Since shoddy is made up of variously colored cloths, the best test is to examine the fabric with a magnifying glass, and if one piece of yarn is found to contain fibers of a number of colors, the presence of shoddy is certain.

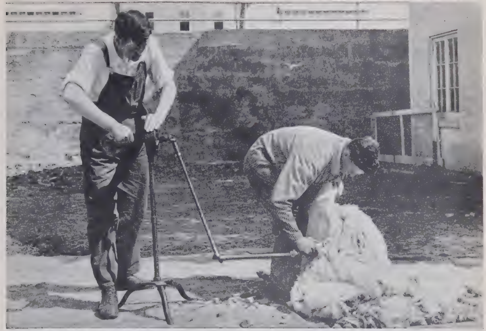
The name "wool" is properly given only to the fiber of the domestic sheep. Other fibers so closely resemble it, however, that they are also called wool in commercial usage. We get mohair from the Angora goat, cashmere from the Cashmere goat of India, and alpaca from the animal of that name which ranges in the South American Andes. The difference between wool and hair is one of degree rather than kind, the wool fibers being commonly finer, softer, and curlier, with innumerable minute scales—from 500 to 2,800 to the inch—which overlap one another like shingles. The curl keeps the yarn from unwinding, and the scales interlock and hold the fibers together. These properties are also used in making felt, which is done by simply rolling or pressing a pulpy mass of wool into a flat mat (*see* Hats and Caps). The elasticity of wool is another distinctive quality, giving woolen fabrics pliability and softness.

Much attention has been paid to breeding sheep for wool. The finest wool is produced by the Merino, a native of Spain which is now found all over the world. It has a short staple, however, and has been crossed with high grade long-wool breeds to develop the highest type of wool fiber. (*See* Sheep.)

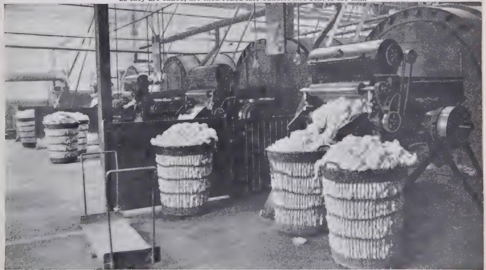
Wool is shorn from the sheep ordinarily each spring, or sometimes twice a year in places of continuous hot weather. Nowadays the shearing is done mostly by machine clippers, run by steam or electricity. With these, expert shearers can handle 150 to 200

(*Continued on page 3787*)

THE PICTURE-STORY OF WOOL—SHEARING AND CLEANING

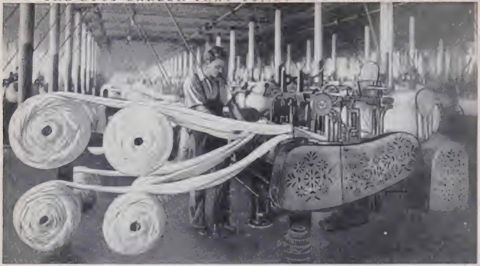


When a skilful shearer clips a sheep the wool comes off in a single piece, as you see in the photograph, and can be laid out as if it were a whole skin, the fibers clinging together because they are curly and overlapping. In remoter districts shearing is still done with hand shears, but on larger ranches it is usually done by machine clippers, operated by an assistant, or by a motor. The fleeces, as they are called, are then rolled into bundles and sent to the mill.

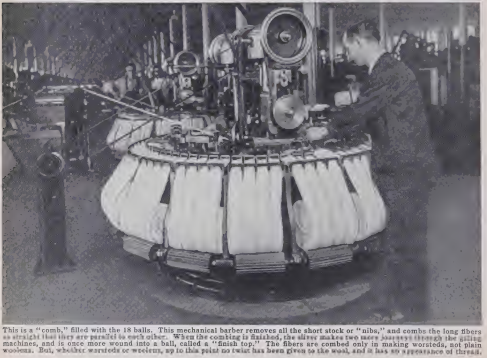


The shearer cuts off the wool as if it were a blanket, but as soon as the fleece gets to the mill it is torn apart, because it must be cleaned and the different parts, which are of varying quality, must be separated. The wool is "scoured," or washed, by passing through a machine which consists of a series of vats containing warm, soapy water. Automatic rakes pull the wool through the machine and sets of rollers wring the water from the wool as it goes from vat to vat.

THE BUSY BARBER THAT COMBS THE WOOL'S HAIR

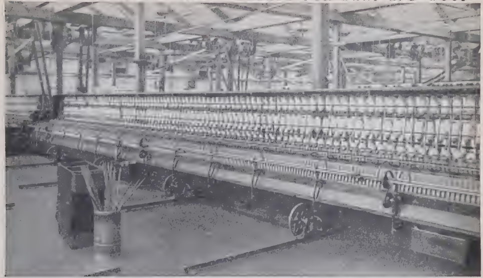


After the wool has been thoroughly dried and all foreign matter removed, it is carded. In this process the fibers are opened and straightened by running between rollers from which countless tiny wires project. These catch and separate the fibers. The wool is then wound into a "sliver" or loose ball, a number of which, taken at one time, are put through a "gilling" machine, such as you see above. This machine straightens the fibers, which come out in the form of soft strands. Four of these strands are then carried to the "balling" machine, which makes them up into a large ball. Eighteen balls are required to fill a "comb."

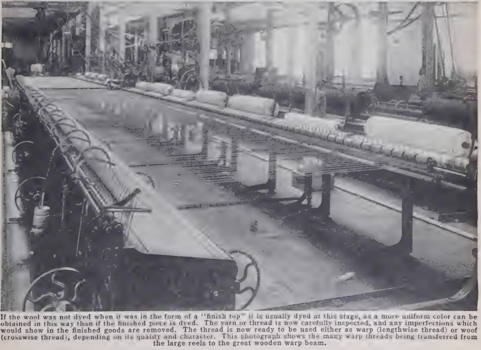


This is a "comb," filled with the 18 balls. This mechanical barber removes all the short stock or "nibs," and combs the long fibers as straight that they are parallel to each other. When the combing is finished, the sliver makes two more journeys through the gilling machines, and is once more wound into a ball, called a "finish top." The fibers are combed only in making worsteds, not plain woolens. But, whether worsteds or woolens, up to this point no twist has been given to the wool, and it has no appearance of thread.

TWISTING SLIVERS INTO THREADS FOR WARP AND WOOF

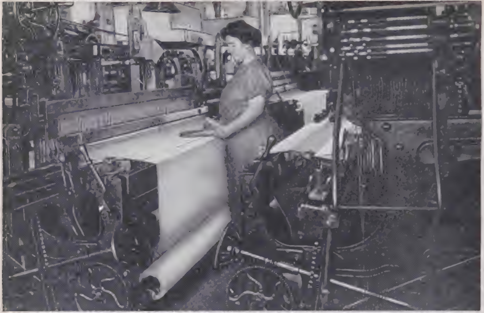


The soft straight wool then takes its first merry-go-round ride. It is run through a machine which twists and draws it into thread, and then it is put through the long spinning machine which you see in the illustration. Here the same process continues until the twisted thread has been drawn to the required size. This twisted thread, sometimes singly, sometimes with three of four threads twisted together in a strand, is used for weaving.

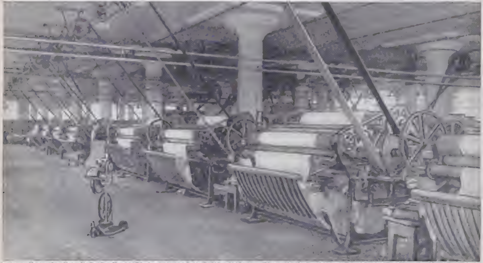


If the wool was not dyed when it was in the form of a "finish top" it is usually dyed at this stage, as a more uniform color can be obtained in this way than if the finished piece is dyed. The yarn or thread is now carefully inspected, and any imperfections which would show in the finished goods are removed. The thread is now ready to be used either as warp (lengthwise thread) or woof (crosswise thread), depending on its quality and character. This photograph shows the many warp threads being transferred from the large reels to the great wooden warp beam.

MECHANICAL SPIDERS THAT WEAVE THE WOOLEN WEB



Modern machinery seems to operate consciously, almost as if it were some highly developed animal or even a human being. If you could watch this great loom perform its duties you would be wonder-struck. While the warp threads were transferred to the warp beams, the woof threads were put on shuttle bobbins, which carry the woof thread across the loom. When the warp beam has been properly harnessed and the weaving is started, the loom operates by what is called a "head motion." This is a mechanical device for raising some of the threads and lowering others, so that the woof shuttles, passing above some threads and below others, fill out the pattern.



These "napping" or "gigging" machines are used to finish woolens. They pluck or raise the ends of the fibers on the face of the cloth by means of a "teasel," a wire brush shaped somewhat like a pine cone. When the nap has been raised to the proper length, it is sheared by a machine which works on the principle of a lawn-mower. Worsted cloth is finished by passing through a brushing machine, which lifts the long fibers, and is then sheared just like woolen cloth. Lastly the cloth is pressed or ironed, and it is then ready for measuring, weighing, and packing for the market.

sheep a day, while a man using hand shears will have done a good day's work in clipping 30. The first and finest clip, called "lamb's wool," may be taken at the age of 8 to 12 months. The fleeces of the older sheep are called "wether wool," and are of relatively less value. Wool taken from the pelts of sheep in slaughter houses is known as "pulled" or "skin" wool, and is inferior to the shorn wool obtained from live sheep.

After shearing, the fleeces are rolled up in bundles and sent to the mill, where they must be sorted. Not only do the various kinds of sheep furnish widely different qualities of wool, but different qualities are obtained from the same animal. The best wool comes from the sides and shoulders. That cut from the head and chest is irregular and likely to be filled with burrs, and that from the lower parts of the body is usually short, worn, and dirty.

Although the fleece may have been washed on the sheep's back by the farmer or flockmaster it still has to be scoured. Scouring rids the wool thoroughly of the stains of earth and dust which it has picked up, and the greasy matter, called "yolk," secreted by the skin of the animal. The wool is then dried and is ready for "mixing"—the blending of several qualities of wool—to produce cloth of the desired quality. If other materials are to be mixed with the wool—as silk, cotton, or shoddy—they may be added at this stage. Usually, however, they are twisted with the wool yarn after spinning, or combined in the weaving.

The wool is now oiled to restore its natural pliancy, and is ready for "carding," an operation which pulls the fibers apart so that they lie loosely, separated in a uniform film. This is done by revolving cylinders covered with leather strips in which fine long wire teeth are fixed. If the wool is to be used for "worsteds" it must be combed in addition to being carded, to make the fibers lie parallel to one another, so that the threads when spun will be regular in shape and hard and compact. The wool for "woolens" is not combed, but after emerging from the carding machine in light strands called "rovings," goes directly to the spinning room, where the mixed and matted fibers are spun into a soft loose irregular thread.

Spinning the Yarn

In the spinning room the fibers are drawn out and spun into a single yarn. The yarns are then twisted into two, three, or four strands, or used singly, depending upon the coarseness or fineness of the fabric to be made. Soft fragile yarn is often used for "weft" or "filling," but the warp threads must be able to bear much greater strain, and are twisted harder. (*See* Spinning and Weaving.) Formerly nearly all woolen goods were dyed after leaving the loom, but now the practice is becoming more general of dyeing the yarn before spinning.

After the cloth leaves the loom another series of operations begins. First the material passes under the inspection of young women who with needle and thread make good any defects of knotted or broken yarns. Then the cloth is saturated with hot water and soap and rubbed between slow-revolving rollers for many hours to give the amount of shrinkage desired. This process is known as "fulling" or "milling." The soap is then washed out and the cloth is stretched so that it may dry evenly. Next the nap is raised in a "teazeling" machine by means of thousands of little steel hooks which scratch the surface, and then trimmed by a very fine machine which acts on the principle of the lawn mower. After being pressed between hot plates and dry-steamed to impart luster, it is finally ready for market.

The United States wool "clip" averages about 300,000,000 pounds each year, most of which comes from the big flocks of the sparsely settled western states. This, however, is less than half of what its mills and factories require, and the rest must be made up from imports, chiefly of low-grade "carpet" wools from the Orient. The wool-manufacturing industry is centered in Massachusetts and Pennsylvania. Australia is the world's largest wool producer, holding the same leadership in its production that the United States enjoys in cotton. South America, Europe, Asia, and Africa are also large producers.

WORCESTER (*wọs'tẽr*), MASS. If ever any city might properly call itself the cradle of invention, it is Worcester, the second largest city in Massachusetts. Within 15 miles of this city's municipal building were born Eli Whitney, the inventor of the cotton gin; Erastus Bigelow, inventor of the carpet-weaving machine; Elias Howe, inventor of the sewing machine; Lucius Knowles, who perfected the modern loom; and the three inventors, Draper Ruggles, Joel Nourse, and J. C. Mason, who perfected the modern plow and devised many other improvements on farming implements.

Worcester is also a manufacturing center. It has drawn enough wire to girdle the globe a thousand times, has facilities for making enough envelopes to carry on the correspondence of the world, and can boast the largest belt factory, the largest loom works, the largest grindstone plant, and the largest automobile crank-shaft forging plant in existence.

Worcester was first settled in 1673, but was twice abandoned on account of trouble with the Indians. But in 1722 it was incorporated as a town and in 1848 chartered as a city. In 1775 Isaiah Thomas moved here from Boston with his paper *The Massachusetts Spy* and made Worcester an important publishing center during the War of Independence. The city today is an educational center, housing Clark University, Clark College, the College of the Holy Cross, the Worcester Polytechnic Institute, a state normal school, and Worcester Academy. The library of the American Antiquarian Society, founded in 1812, contains a rich collection on American history and some interesting portraits.

More than one-third of the population are of foreign parentage, representing 40 different nationalities. Population, about 193,000.

WORDSWORTH, William (1770–1850). William Wordsworth, the interpreter of nature, the great poet-lover of humanity, and the leader in the poets' revolution back to simple truth and beauty, was born April 7, 1770, at Cockermouth, England, a little village on the River Derwent among the beautiful hills of Cumberland. He came of a family of landowners, and from his earliest days had a deep love for simple country life and for the beautiful region in which he lived. In this outdoor wonderland the serenity of the murmuring Derwent, of the sounding cataract, of forest shadows at noonday, a mountain peak at dawn, or lonely "waters on a starry night" were woven into the very depths of his being.

WORDSWORTH'S HOME AT RYDAL MOUNT

In this charming cottage in the famous English Lakes District, Wordsworth lived from 1813 to 1850. It was only on rare occasions that he left it even temporarily, and he always returned to it with joy. With him lived his wife and his beloved sister Dorothy, and not many miles away was Southey, one of his closest friends and his predecessor as poet laureate. Wordsworth, Southey, and Coleridge were the original "Lake" Poets, whose work marked the beginning of the Romantic movement in 19th century English literature.

Wordsworth took his degree at Cambridge University in 1791, without any particular distinction. His life was singularly uneventful except for visits to the Continent. It was on the second of these that he threw himself fervently into the cause of the French revolutionists and was just about to join the Girondins when his disapproving family stopped his supplies, and the lack of money brought him home toward the close of 1792. For three years he lived in an unsettled fashion without prospects or profession until, upon receipt of a legacy from a friend, he took a cottage in Dorsetshire with his sister Dorothy, resolved to devote his life to poetry.

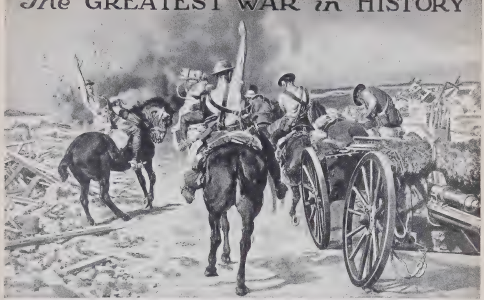
Wordsworth's life from this time on was one of "plain living and high thinking." In 1797 the poet settled at Alfoxden in Somersetshire, where under the stimulating friendship of Coleridge he began his really important writing. The two poets wandered, talked, and walked and worked together, producing in 1798 their famous collection of 'Lyrical Ballads'. In the second edition of this anthology Wordsworth startled the literary world by declaring that poetry was the "spontaneous overflow of powerful feelings," and that poets should have for their creed simple scenes, everyday words, truth to nature, and imagination. In the book itself were such splendid applications of this creed as Coleridge's 'Ancient Mariner', and Wordsworth's 'Lines above Tintern Abbey', 'Michael', and 'The Revery of Poor Susan'.

In spite of the ridicule which his themes and his frequent lapses into commonplace provoked, Wordsworth kept on writing for the rest of his long life, composing many very dull and a number of very beautiful poems, and doing most of his best work by 1807. He made his home for the last 50 years of his life at Grasmere and Rydal Mount in the Lake Country in the North, where, in 1802, he married his cousin, Mary Hutchinson. Gradually he won public favor, and was made poet laureate seven years before his death in 1850.

In his long poem 'The Prelude' this serene poet gives an account of his mental growth and tells how his boyish love of nature's physical beauty changed to an appreciation of the tranquillizing spiritual kinship between Nature and man. "To me the meanest flower that blows can give thoughts that do often lie too deep for tears," he cries. In many of his simple and beautiful poems Wordsworth reveals to us the beauty, harmony, and sublimity of Nature. Wordsworth is undramatic and lacks broad sympathy with human nature. But his best nature poems, a number of his exquisite sonnets, and several of his simple and touching peasant poems in which he lifts the commonplace into genuine poetry, are immortal. As Wordsworth's poetic disciple Matthew Arnold puts it: "Wordsworth's poetry is great because of the extraordinary power with which Wordsworth feels the joy offered us in Nature, the joy offered us in the simple affections and duties; and because of the extraordinary power with which he shows us this joy, and renders it so as to make us share it."

Wordsworth's finest poems are 'The Solitary Reaper', 'Michael', 'Lines above Tintern Abbey', 'Daffodils', 'Intimations of Immortality', some of the 'Lucy' poems, 'Westminster Bridge', 'The World is Too Much with Us', and 'To Milton'. His published works include: 'An Evening Walk' and 'Descriptive Sketches' (1793); 'Lyrical Ballads' (1798); 'Poems' (1807); 'The Excursion' (1814); 'The White Doe of Rylstone' (1815); and 'The Prelude' (1850).

The GREATEST WAR *in* HISTORY



"Halt!"—Road Torn up by Shell Fire in Path of Advancing Battery

WORLD WAR OF 1914–1918. A map of the world showing the nations at war during 1914–18 would include nearly all of Europe, Asia, Africa, North America, and a very large portion of South America. The title "World War" is therefore a fitting one to apply to this greatest conflict in all history. Against Germany and her allies, Austria-Hungary, Turkey, and Bulgaria, were arrayed 24 nations—Serbia, Belgium, Russia, France, the British Empire, Japan, Portugal, Montenegro, Italy, San Marino, Rumania, Greece, United States, Brazil, Cuba, Panama, Haiti, Guatemala, Honduras, Costa Rica, Nicaragua, Liberia, China, and Siam. Six others—Bolivia, Ecuador, Santo Domingo, Peru, Uruguay, and Egypt—broke off all relations with Germany. Indeed only 16 countries—the chief being Holland, Spain, Norway, Sweden, Denmark, Switzerland, Argentina, Venezuela, Chile, Colombia, and Mexico—containing less than one-fourteenth of the world's population, remained neutral in the stupendous conflict.

Not only in numbers of people involved, but in other ways, the great World War makes all previous conflicts pale into insignificance when compared to it. The size of the armies and navies raised on each side would have astonished the conquerors of old. The amount of money spent seems fabulous. It has been estimated that the direct cost of the war was about $200,000,000,000, a sum which if coined into silver dollars and piled up along the western battlefront would make a wall 475 miles long, 2 feet thick, and 6 feet 8 inches high. The United States alone spent as much money as it did on all the expenses of the government from 1791 to 1914. The number of men who were killed or wounded amounted to about 30,000,000. The guns and supplies necessary to support the vast military hosts called for the most efficient organization the world had ever seen—an organization which included not only soldiers in uniform, but unnumbered men, women, and children who labored to supply the countless needs of the enormous armies.

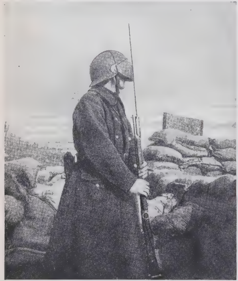
How the War Started

Francis Ferdinand, the heir to the throne of Austria-Hungary, was murdered, June 28, 1914, at Serajevo (Bosnia) by a young Slav, one of the millions living in Austria-Hungary who for years had longed to throw off the Austrian yoke and join with their kinsmen in the Serbian kingdom to the south. Austria accused the Serbian government of having encouraged the crime, and presented an ultimatum to Serbia making very humiliating demands upon that little country. The Serbians yielded to all the demands of the arrogant Austrian government except two, which would have dishonored them as a nation. They suggested that these two be referred to the Hague Tribunal or to the great powers for arbitration. Immediately (July 28, 1914) the Austrians declared war on Serbia. Serbia appealed to Russia, which came to the assistance of the little country. Germany, whose government had blocked the attempt of

British statesmen to find a peaceful settlement, then entered on the side of Austria-Hungary, and France immediately took up the gauntlet by the side of her ally, Russia.

On Aug. 2, 1914, Germany, in order to strike France from behind, demanded of Belgium the right to march through her territory into France.

READY FOR THE ONSLAUGHT



Here stands a Belgian sentry fully armed, as a symbol of his nation's determination to meet the oncoming foe. The Belgians could not turn back the German flood, but they could and did hold it in check, at terrible cost, until their British and French allies could come to their aid.

The Belgian government promptly replied: "If we accept the proposal submitted to us, we would sacrifice the honor of the nation and betray our duty towards Europe." Why was this so? Because upon several occasions, beginning as far back as 1839, the European nations, including both Prussia and Austria, had agreed that Belgium was a neutralized country and therefore should never be made the scene of war. But in spite of this solemn agreement, the Germans marched into Belgium, their only excuse being that it was "necessary" for them to do so, "and necessity knows no law."

"A Scrap of Paper"

National self-interest as well as her plighted word led Great Britain to join France and Russia, when Belgium was invaded. Bethmann-Hollweg, the German chancellor, declared Great Britain went to war "just for a scrap of paper." With Great Britain, however, the solemn treaty guaranteeing the neutrality of Belgium was no "scrap of paper." Japan entered the war three weeks later in fulfillment of treaty obligations to Great Britain.

The murder of the Austrian archduke was thus the spark which set the world on fire. It was, however, the occasion and excuse for the war, rather than its real cause. The real causes lay more remote. For years Austria-Hungary had sought to dominate the Balkan peninsula, and had consistently refused to give Serbia even an outlet to the sea. She wished the Serbians to remain merely "a nation of swineherds." Austria-Hungary resented, therefore, the increased power and prestige gained by Serbia in the war of the Balkan allies with Turkey in 1912–13.

Germany Supports Austrian Demands

Of course Austria-Hungary would never have dared to go to war unless Germany had supported her. Indeed there is abundant proof to show that Germany really encouraged Austria-Hungary to be so arbitrary with Serbia, and thus to begin the war. For years Germany had excited the dislike of other nations. France could never forget how Germany had robbed her of Alsace-Lorraine. Moreover, the Germans had upon several occasions rudely interfered with the French occupation of Morocco. Most of all, however, Germany was jealous of the trade and colonies belonging to Great Britain. For that reason the Germans, who already had the greatest army in the world, had begun to build an enormous navy, although they knew that Great Britain, because of its island character, would not permit the supremacy at sea to pass from its hands. As the German navy and army grew in size the Kaiser grew bolder, and frequently spoke of Germany's "place in the sun," and its "mission" in the world, and breathed threats of war. But Russia, France, and England were by no means blameless. Like all the other nations of Europe they had long followed a policy of aggressive nationalism and jealous trade rivalry, and the formation of the Triple Entente had bound them together in what seemed to Germans a menacing policy of "encirclement." Economic imperialism and nationalist militarism were the real forces which set Europe on fire.

When too late, Emperor William II sought to brake the wheels of the war machine he had so recklessly set in motion. The German ultimatums to Russia and France (July 31), which first widened the area of the conflict, seem due to a panic fear that those nations were already engaged in secret mobilizations which would deprive Germany of the initial advantage resulting from her greater preparedness for war.

"All former experience in war may as well be thrown upon the scrap heap," declared the French General Joffre soon after the World War began. In the first place, instead of individual battles lasting a day or two at various places, there was practically one continuous battle lasting for more than four years on a battle front that stretched for 300 miles from the English Channel to the Swiss border; and similar battle lines existed on the Russian and Balkan fronts on the other side of Europe.

The weapons used in the war exceeded anything ever devised before. Airplanes and submarines came in for extensive use in war for the first time. Huge guns—some of them capable of throwing shells 70 miles—guns that had hardly been dreamed of before the war, crumbled the strongest forts; while the bombardment by rapid-fire and middle-weight guns and machine guns, especially in the "barrage" firing just before an attack, was on such a vast scale as to make trench warfare a necessity. The intricate and extensive trenches, three or four lines deep with frequent communication trenches, were defended by entanglements of barbed wires fastened to stakes. In the trenches grenades, some thrown by hand and others shot from guns, became important factors in the war. Finally there were the land monsters of the war called "tanks"—giant armored automobiles with caterpillar treads, carrying machine guns and small cannon—which defied the bullets of the enemy, smashed wire entanglements, trenches, and machine gun nests, and did much to bring the war to a successful conclusion for the Allies.

FRENCH INFANTRY IN A TRENCH

These French soldiers are awaiting an attack. Note how the sides of the trench have been strengthened with poles and branches, and note also the screen or "camouflage" of leafy branches in front of the trench.

No one could object to new devices in war so long as they were used in a fair way. It did seem, however, as if the Germans were mad with a lust of power and the determination to win the war. The Kaiser had once told his soldiers to terrorize their enemies "like the Huns of old," and the deliberate use of "frightfulness" (*schrecklichkeit*) was enjoined in their war manuals. In this war they began by taking as hostages and shooting civilian men and women in innocent Belgium, and burning and pillaging towns as they advanced. Later they destroyed machinery and tools on the farm and in the factory, when they did not find it profitable to remove them to Germany. They deported thousands of men and women from the districts they conquered and set them to work in Germany, and they reduced others to suffering and starvation. When the Germans were compelled to retreat from a district, they destroyed houses, filled up wells, cut down the fruit trees, and left the region desolate and barren. Upon one occasion Mr. Sharpe, the American ambassador to France, declared after visiting a great area in France which the Germans had just evacuated: "I left with the conviction that history records no parallel in the thoroughness of destruction wrought by a victorious or a vanquished army."

Many of the new devices which the Germans invented were used in the same cruel and inhumane way. The chief of these was the terrible poison gas. Like a yellow cloud it came floating toward the trenches near Ypres for the first time in April 1915. The gas penetrated throats and lungs and many of the surprised soldiers died in most intense agony. Gas masks had to be devised to meet this new weapon, but, happily, it was done so successfully that, although gas in more and more deadly form was continually manufactured—and by both sides—it ceased to be the terror it had once been. The Germans also devised liquid fire made from burning oil, which they used to spray on the Allied trenches as they attacked.

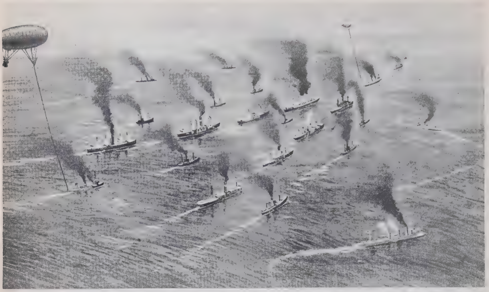
Most cruel of all practices, however, was the German use of submarines, which, contrary to international law and practice, were directed against many passenger and freight vessels, neutral and enemy, as well as against all war vessels. The German submarines lurking under the waves, without warning of any sort, torpedoed helpless vessels and left all on board to perish, unless perchance they were picked up by a friendly vessel. When the great ocean liner *Lusitania* was sunk off the coast of Ireland, on a voyage from New York (May 7, 1915), 1,198 lives were lost, including men, women, and children, of whom 124 were Americans.

This policy of sinking vessels without leaving a trace (*spurlos versenkt*) called down upon the Germans the just indignation of the whole world, and became a chief reason of America's entering the war.

The Belgians Upset German Plans

When the Germans marched into neutral Belgium to attack the French from the north, the Belgians felt in honor bound to resist the mighty German hordes as best they could. Their determined stand, especially at Liége, upset the German program and made the German army ten days late in arriving at the French frontier. General Joffre, the French commander, was thus given time to shift and reorganize

ESCORTING MERCHANT SHIPS THROUGH THE "U-BOAT ZONE"



This picture shows how merchant ships and troop transports traveled between America and Europe during the World War. Far out ahead is a destroyer, followed by a scout cruiser and a torpedo-boat towing a kite-balloon. Then come the two files of big merchantmen, with trawlers between them and on each flank. These trawlers act as moving shields to stand in the way of torpedoes. At the rear is another torpedo-boat with its balloon. From these balloons enemy submarines can be detected, even when they are submerged. Finally, far out on each side. swift destroyers comb the waters in a zig-zag course, ready to attack and sink any U-boat which appears.

his forces to meet this unexpected attack, and the British sent 100,000 men. This force, with a single French army, tried unsuccessfully to stop the German rush at Mons-Charleroi, then fell back upon the main French army near Paris.

When the Germans and the Allies were facing each other across the Marne, General Joffre felt the time had come for his counter attack. From the 6th to the 10th of September, 1914, the historic battle of the Marne raged—"one more decisive battle of the world for Europe, conceivably the greatest in permanent meaning since Waterloo." The result was that the Germans were forced to retreat to positions behind the Aisne and Vesle rivers, foiled in their plans to overwhelm France at one decisive stroke.

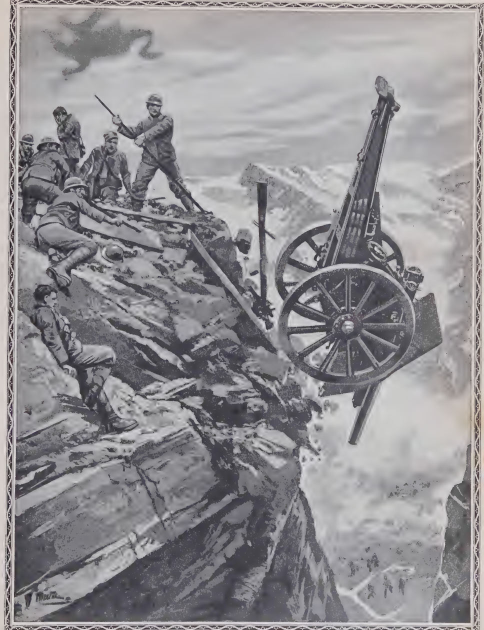
A Temporary Stalemate

The Germans did not stop in their retreat northward until they reached a line running about parallel with the Aisne River. There, after a battle in which neither side could gain a decided advantage, both the Allied and German armies "dug in," facing each other. This was the beginning of the trench warfare that lasted throughout most of the remaining four years of the war. The Germans succeeded in extending their lines to the North Sea at Ostend and Zeebrugge, and also in taking Antwerp from the Belgians, in spite of British aid, on Oct. 9, 1914. There were left to the brave little Belgian army only a few square miles of land in the extreme western corner of the country; there the Belgians successfully defended themselves until the end of the war, by cutting the dikes and letting the water flow over the lowlands. In the first battle of Ypres (which the British Tommies persisted in calling "wipers"), the "contemptible little army" of Great Britain defeated the German attempt to capture Calais and the northern coastline of France (October–November, 1914).

In the following spring the French attacked the German positions north of Arras, and in September east of Reims, but the gains were not worth the heavy losses. In March and April the British made costly local gains at Neuve Chapelle and near Ypres; but late in April the Germans, using poison gas, attacked northeast of Ypres. The gas routed some French Colonials, and for a time the road to the Channel was open; but the Canadians blocked the passage, and a month of heavy fighting finally insured Allied possession of the position.

These events demonstrated to the French and British that they were not yet strong enough to drive the Germans out of France. Therefore they decided to make 1915 largely a year of preparation in the west. The British cabinet was reorganized on a war basis, and the British army was increased to several millions. Steps were also taken both in France and Great Britain to speed up the production

"THE ENEMY MUST NOT GET THE GUNS!"



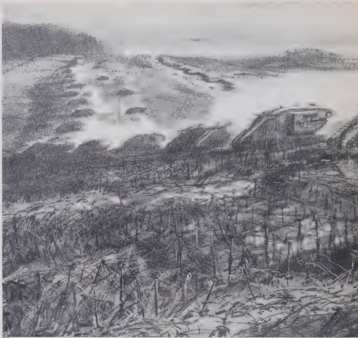
These Italian artillerymen are hurling one of their guns over the edge of a precipice to keep it from falling into the hands of the Austrians. Much of the fighting on the Austro-Italian frontier was on snow-capped mountains, where it was impossible to move heavy artillery except slowly and after extensive preparation. If either side were unexpectedly compelled to retreat, the guns had to be left behind. In such cases they were either blown up or sent hurtling over a cliff as we see here. In such mountain tactics, whether on the attack or defense, the Italians showed remarkable skill and courage.

of war material, so that in "the great push," as they called the intended offensive, there should be plenty of supplies available.

The year 1916, however, did not open well for the Allies. In February the Crown Prince, the Kaiser's oldest son, suddenly launched a great attack on the French fortress of Verdun, near the German border. Verdun was the key to the entire French defense, and if it gave way the French front would likely collapse. Some of the city's forts were taken by the Germans; then the French defense stiffened and became like a stone wall. "They shall not pass" was the watchword of General Pétain, and although the Crown Prince sacrificed 500,000 men, Verdun remained secure.

When it seemed that Verdun was safe, the French and British in turn began an offensive on the Somme River northeast of Paris. By the use of large guns in numbers heretofore unknown they gradually moved forward, capturing such places as Peronne and Albert. By the end of the year they had driven into the German line a wedge of considerable size to a depth of nine miles, which threatened the German positions in the west. But this was won at the cost of terrible losses, amounting to about 800,000 men.

A FLEET OF STEEL FORTS ON WHEELS



What a strange sight—these long rows of steel monsters making a charge! They don't look as if they belonged to modern times. They might rather be cousins of some of those queer, huge turtles of the Age of Reptiles, waddling off in a crowd to their nesting places in the sand. These steel fighting machines are "tanks," and the smaller ones are called "baby" or whippet tanks. Ungainly, grotesque in appearance, the tank proved to be one of the most effective weapons of the many which were first used in this war. For the tanks are really huge moving

Varying Fortunes on the Russian Front

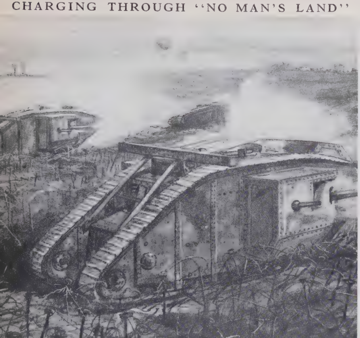
Meanwhile, war on an equally huge scale was being waged on the eastern front. Counting upon a slow mobilization of the Russians, Germany had planned to first destroy France, and then to deal with Russia at its leisure. But Russian mobilization was surprisingly rapid, and soon their forces were in the heart of East Prussia. The resulting necessity of withdrawing German troops from the west front helped to produce the German defeat on the Marne.

At Tannenberg, however, in the last week of August, 1914, and again a week later in the battle of the Mazurian Lakes, the Russians were crushingly defeated and forced to retreat. This result was largely due to the treachery of the Russian general Rennenkampf. A second Russian invasion, in the spring of 1915, again came to grief among the Mazurian Lakes, losing thousands of soldiers in killed, wounded, and prisoners. As a result of these two battles East Prussia was freed from the Russians, and Hindenburg, the German commander there, became the popular idol of Germany.

Farther south the Russians had greater success, and in 1914 they overran nearly the whole of the Austrian province of Galicia. Early in 1915 they began to pour through the Carpathian Mountains into Hungary itself. In the summer of that year, however, the Austrians and Germans, commanded by Mackensen, defeated the Russians badly in Galicia and drove them many miles to the east. At the same time Hindenburg started an offensive from East Prussia. The Russians soon found themselves within the jaws of a giant pincer which finally compelled them to evacuate the whole of Russian Poland. The year 1915 was therefore a year of disaster for Russia. In 1916 an attempt was made to retrieve their fortunes by a new invasion of Austrian territory, and 500,000 Austrian prisoners were captured; but on account of lack of supplies the Russian commander was unable to follow up his victory.

Although it was against Serbia that the first declaration of war by the Austrians was made, the Austrian invasion of Serbia did not begin until Nov. 10, 1914. The Austrians captured Belgrade the capital, but later the Serbians badly defeated the invaders, driving them back across the Danube.

CHARGING THROUGH "NO MAN'S LAND"



forts. They carry machine guns and sometimes heavier equipment, and they can advance, dealing death in all directions, over obstacles of every kind. Ditches, ravines, trenches, barbed wire entanglements—all these are nothing to the iron monsters who lay their track and pick it up as they go. Much of the effectiveness of the tanks was due to this feature, for the "caterpillar," the cleated endless belt, gives a greater traction power than wheels and makes it possible for tanks to operate in places impassable for wheeled vehicles or even men on foot.

In the following year, however, the Austrians were reinforced by German troops. Besides, Bulgaria had now joined Germany and Austria, and declared war on Serbia (Oct. 13, 1915). Powerful armies therefore advanced from the north and southeast on the unfortunate little country, and between these huge forces both Serbia and Montenegro were completely crushed (November and December 1915). Only a remnant of the Serbian army, suffering terribly from hunger and cold, escaped with their aged King Peter, through the mountains of Albania to the seacoast, where they were taken on board warships of the Allies, and carried to the island of Corfu for refitting. Later the Serbians gave a good account of themselves on the Saloniki front of northeastern Greece.

In the year 1916, while the Allies were momentarily winning victories on both the western and eastern fronts, Rumania joined hands with the Allies. Her purpose was to liberate the thousands of Rumanians included in the Hungarian kingdom. The Rumanian army began an invasion of Hungary, but not being adequately supplied and being attacked in the rear by Bulgaria, it was soon halted and was forced to retreat. The retreat presently became a rout, and in the face of an overwhelming Austro-German army the Rumanians had to give up their capital Bucharest and all the western half of the kingdom, rich in oil and agricultural products. Rumania was looted as Belgium, northern France, Serbia, and Poland had been, to feed the insatiable maw of the German war demon. The end of the year found the Rumanian army crowded into Eastern Rumania and suffering intensely from want of clothing and supplies.

Although Italy had long been allied with Germany and Austria in the Triple Alliance, she refused to join them in the war of 1914, because that was an offensive war and she was bound to aid only in a war of defense. After long negotiations Italy entered the war on the Allied side (May 23, 1915), after a secret treaty was signed promising her the Austrian districts of Trentino, Trieste, and Dalmatia, where the population was very largely Italian. This freed France from the necessity of maintaining an army on the Italian frontier, and so contributed to the Allied success in the battle of the Marne.

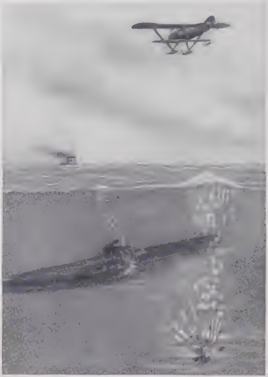
The Italian army succeeded in 1915 in taking Austrian territory in the Trentino district and along the Isonzo River. In the following year they advanced across that river, taking the Austrian stronghold of Gorizia (Aug. 9, 1916), and threatening the great seaport of Trieste.

Campaigns in Distant Countries

Turkey openly cast in her lot with Germany and Austria in October 1914, and her army soon made an unsuccessful attempt to seize Egypt and the Suez Canal, both of which were under British control. The British then landed an expedition on the narrow Gallipoli Peninsula, which forms the western shore of Dardanelles Strait, as preparation for a naval attack upon Constantinople. The Gallipoli expedition proved to be a costly failure, however, and in January 1916 the troops were withdrawn. A British expedition under General Townshend which had advanced up the Tigris River from the Persian Gulf also met disaster and was forced to surrender to the Turks (April 29, 1916). In the region of the Caucasus Mountains, however, the Russians defeated the Turks, captured the important city of Trebizond on the Black Sea, and rescued nearly the whole of Armenia from the Turks, who had often indulged in cruel and revolting massacres of helpless Armenians.

In other parts of the world the Allies were generally successful. Japan seized the German possessions in the Shantung peninsula of China, in November 1914. The German colonies in the Pacific were promptly captured by Australian and New Zealand troops. General Botha, a former Boer general in the Boer War with Great Britain, now proved his loyalty by leading an expedition of South African troops which took German Southwest Africa in 1915. Togo and Cameroon, two German colonies on the west central coast of Africa, also fell to the Allied forces. By the end of the year 1916 the conquest of German East Africa had practically been completed by General Smuts and an army from British South Africa, thus depriving Germany of all her former overseas possessions.

THE FINISH OF A SUBMARINE



A depth bomb need not actually strike a submarine in order to disable it or even destroy it. So tremendous is the shock of the explosion that it is usually enough to put the "sub" out of action even if the bomb falls at a considerable distance away. This picture shows the explosion of a depth bomb dropped from an airplane. The bubbles of air and oil rising to the surface above the U-boat indicate that the outer shell of the boat has been damaged, and that the submarine will either sink to the bottom or be forced to rise and surrender.

No sooner had German wireless flashed abroad the news of war than German merchant vessels everywhere sought safety in home or neutral ports, according to pre-arranged plans. The German fleet also retired to safe waters behind the German island fortress of Helgoland and at the mouth of the Kiel Canal, where it remained securely "bottled up." Within a few days Germany's vessels and trade were practically swept from the ocean. To be sure, a few commerce raiders such as the *Emden* led a spectacular career in the East Indies for several months before they were captured or destroyed; three British cruisers were sunk by submarines in the North Sea; and a German squadron won a victory over an inferior British squadron in the South Pacific. But soon that German squadron was sunk by the British near the Falkland Islands (Dec. 8, 1914), and thereafter the German high-seas fleet did not challenge the Allied control of the ocean until the battle of Jutland, May 31, 1916. This was the most important naval conflict of the war. The British cruiser fleet encountered the German high-seas fleet off the Danish coast in the late afternoon. The mists were heavy, and by the time the British dreadnaught fleet arrived on the scene, oncoming night made it difficult to sight the guns at the long distances at which the battle was fought. The results were indecisive. Six capital ships were sunk by the Germans, to two by the British. But the German fleet retired, and thenceforth played no appreciable part in the war.

From the beginning the Germans had placed great hopes in their submarines. The torpedoing of the three British cruisers, mentioned above, indicated that the hugest of war ships unless carefully guarded were at the mercy of these undersea craft. With a sufficient number of submarines the Germans hoped to destroy British and French commerce with little or no interference from the Allied fleet, and the thought of thus cutting off British commerce and starving that country into submission so intoxicated the Germans that they began feverishly to build more and more submarines.

On Feb. 4, 1915, Germany issued a proclamation in which she claimed to blockade the entire French and British coasts. Any vessel, whether belonging to a neutral country or to one of the Allies, was declared to be in danger of destruction by submarines if found within the forbidden zone. So vigorously did the German submarines carry on this campaign that by the end of the year 1916 the British merchant marine had lost heavily. Neutral countries also, including the United States, had lost almost one million tons of shipping and many lives.

LEARNING WHAT TO DO IN A GAS ATTACK

Long before they went overseas, the American soldiers received their first training in the use of poison gas and the methods of avoiding its harmful effects. They were taught how to adjust their gas masks with the greatest possible speed, for a single whiff of some of the gases used in war is enough to put a man out of action. Even the army nurses, as you can see from the lower picture, were given this same training.

The year 1917 opened well for the Allies. The wedge which they had driven into the German line on the Somme River, during the previous summer, seriously menaced the German positions. Under these circumstances the Germans evacuated a large area of French territory on a front of 100 miles, from Arras to Soissons. As they retreated they ruthlessly destroyed everything of any value until they reached their new positions, called the "Hindenburg Line." By this maneuver they straightened and shortened their battle line by about 40 miles.

With the hope of turning this line, the British struck its north extremity from a point southeast of Arras to Vimy Ridge at the north, on April 9. The Canadians carried the ridge in a gallant assault, and the attack penetrated five miles. On April 16 the French struck the southern extremity along the Chemin des Dames between Soissons and Reims; but their local gains were not worth their terrific losses, and the attack was broken off. This battle robbed the French of their offensive power for the rest of the spring and summer, and while they were recovering the British carried the burden of the attack.

For the purpose they selected the region about Ypres, and commenced operations by capturing the Messines-Wytschaete Ridge (June 7–14). This removed an awkward salient, and made possible a campaign by which, between July and November, the British drove the Germans from Passchendaele Ridge and weakened Germany's hold upon western Belgium. To end the year, they attacked farther to the south, near Cambrai. Here a large force carried out a surprise attack in which "tanks" were first extensively used. It succeeded admirably at first, until the British themselves were taken by surprise and lost nearly everything they had gained. In the meantime the French won important victories north of the Aisne River. Although the French and British were unable to push the Germans out of France during 1917, they had won some substantial victories, and were confident that Germany would ultimately be beaten.

Toward the end of the year, however, these hopes received a rude shock in Italy. There during the summer the Italians had made steady progress through extremely difficult country toward their goal, the city of Trieste. But in their zeal to capture this city they left the line of battle on the upper Isonzo River poorly guarded. In this region, late in October 1917, the Austrians and Germans suddenly descended like an avalanche upon the Italian forces at Caporetto.

A terrible rout was the result, which undid the work of two years, and cost the Italians about 200,000 prisoners and 2,000 cannon. Only on the line of the Piave River were the Italians able to stop the retreat, and for the next year this remained the battle line of the Austrian and Italian forces.

SURE DEATH TO THE ADVANCING FOE

These two gunners, masked against poison gas, are operating a machine gun. Notice that the cartridges are carried in a belt or strip which is automatically drawn through the machine. As one cartridge is fired, the next jumps into position. So rapid is this movement that the gun can spit out a stream of 600 shots a minute.

The Italian disaster cast a spell of gloom over all the Allies. This was somewhat relieved early in December when the city of Jerusalem, after many centuries of Moslem rule, fell into the hands of General Allenby and the British and Arab expedition which had crossed into Palestine from Egypt. Earlier in the year General Maude with a British expedition captured the city of Bagdad on the Tigris River, thus accomplishing the feat which General Townshend had failed to perform in the previous year.

Two events, however, overshadowed in their importance all other happenings of this momentous year. The first was the beginning of a revolution which ended the despotism of the czars in Russia and finally led to the withdrawal of that country from the war. The second was the entrance of the United States into the conflict.

Russia Makes Peace with the Central Powers

During the first three years of the war, the Russian army suffered many defeats because it was poorly equipped with arms and supplies. Russia's soldiers had entered the conflict enthusiastically and fought bravely. But they could not stand up against the array of machine guns and the vast batteries of light and heavy artillery of the Germans, and therefore they had lost heavily to the Germans in killed, wounded, and prisoners. In fact no nation in the war suffered to anything like the extent that Russia did. All this was rightly blamed upon the incompetent and corrupt officials surrounding the Czar.

On March 11, 1917, a revolution broke out in Petrograd which resulted, four days later, in the abdication of the Czar. Steps were taken at once to form a new republican government and to prosecute the war vigorously. In the course of time, however, groups of workingmen and soldiers established councils (*soviets*) and secured control of all affairs. The old army officers were everywhere banished and military discipline collapsed. The cry was raised that the war was the affair only of imperialistic and capitalistic governments, and the peoples had no cause to fight each other. Thousands of Russian soldiers, tired of the war, deserted and fled to their homes. The line of battle which had been so stubbornly defended against German attack practically disappeared. The Bolsheviki government, controlled by the two radical Socialists Lenin and Trotzky, which came into power in November 1917, refused to pursue the war any further, and in December an armistice was arranged with the Germans. Early in March 1918, the Bolsheviki government signed a most humiliating treaty with the Germans at Brest-Litovsk.

According to the terms of this peace, the Russians lost Poland and nearly all the territory bordering on the Baltic Sea. They were also required to surrender a great area of land in the Caucasus Mountains to Turkey, and pay a huge war indemnity to Germany. The terms were hard and Lenin complained bitterly of the Germans: "Their knees are on our chest, and our position is hopeless." Later evidence went to show, however, that neither the Bolsheviki nor the Germans sincerely intended to keep the peace.

A crowning horror of Bolshevist rule was the brutal murder of the unhappy Czar Nicholas II with all his family, in July 1918.

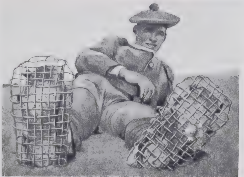
While the treaty of Brest-Litovsk proved of less benefit to Germany than was expected, so far as obtaining supplies from Russia was concerned, it did enable the Germans to transfer many thousands of soldiers from the eastern to the western front. Henceforth the Allies in the west had to bear the entire brunt of the German attack, without the powerful assistance which the Russians had rendered during the first three years of the war. It was at this time, when the Allies were taking measures to face the new German strength obtained by release of troops used in Russia, that the United States entered the war.

How the United States was Goaded into War

From the first, the sympathy of the majority of the people in the United States was undoubtedly with the Allies and against Germany. This was because the Germans had invaded little Belgium, a neutral country, in order to strike France from behind, and also because the Germans carried on the war in an inhumane manner, burning villages, shooting hostages, and startling the world by such executions as those of the English nurse, Edith Cavell, and Captain Fryatt, commander of a British merchantman which rammed and sank a German submarine. At that time, however, the people of the United States did not wish to interfere in what seemed to be a purely European quarrel in which America had no direct concern.

But in a short time the American government was confronted with a number of questions which directly concerned it, owing to the way the European nations conducted the war. With her huge fleet Great Britain cut off all commerce with Germany except that in the Baltic Sea. It soon became apparent, however, that large amounts of war supplies were finding their way into Germany through such neutral countries as Denmark, Norway, and Holland. The British therefore insisted on limiting the amount of such goods shipped to those countries to what they themselves needed. Neutral countries, including the United States, protested against this interference with their trade, but in vain.

SAND-SHOES FOR SOLDIERS



Have you ever tried to walk fast on a sandy beach? Then you know what hard work the British forces in Palestine and Mesopotamia had in their long marches across the sands. The camels' feet spread out like pads and keep him from sinking. Using the same principle, the British put their shoes into wire cages, like these, and thereafter walked with comparative ease.

In the meantime Germany also began interfering with the rights of neutral vessels on the sea. On Feb. 4, 1915, the German government announced that the waters surrounding Great Britain and Ireland were included in the war zone, and that all vessels therein, whether belonging to the Allies or to neutral countries, were in danger of sinking by submarines, with all passengers and crews, without warning. President Wilson immediately notified Germany that this was a flagrant violation of American rights on the sea, and that Germany would be held responsible for any loss of American lives and property.

Most people in America refused to believe that the Germans would actually attempt to carry out such a ruthless policy of naval warfare. Nevertheless, within three months almost a hundred vessels, many of them belonging to neutral countries, were destroyed by mines or German submarines. When news came of the sinking on May 7, 1915, of the great British liner *Lusitania* off the Irish coast, with a loss of over a thousand lives, 124 of them American, a wave of indignation swept over the entire United States. Although some pro-Germans excused or justified the sinking, many persons talked freely of going to war with Germany. President Wilson wished if possible to induce the Germans to give up their indefensible submarine policy without resorting to war. The answer to the German argument that the British also had interfered with American commerce, was voiced by President Wilson in these words: "Property can be paid for; the lives of peaceful and innocent people cannot be." The warning that a repetition of such acts would be regarded by the United States as "deliberately unfriendly" led the Germans for a time to cease torpedoing vessels without warning.

One of the assertions made by the Germans during the course of these negotiations was that the *Lusitania* carried munitions of war "destined for the destruction of brave German soldiers." In an American court this was proved absolutely false — "she was not and never had been armed, nor did she carry any explosives." Nevertheless the Germans continued to complain bitterly about Americans selling munitions to the Allies. The American government immediately pointed out that all countries, including Germany herself, had always sold munitions of war to other countries at war whenever it suited their interest to do so. The United States was willing to sell munitions to the Germans as well as to the Allies—all that Germany had to do was to come and get them.

In a short time it became apparent that German war lords did not sincerely intend to give up their submarine policy. A number of other vessels were soon torpedoed without warning. The sinking of the passenger ship *Sussex* in the English Channel was so flagrant that the United States was again on the verge of declaring war. Germany now realized that the patience of the United States was about exhausted, and so gave a pledge not to sink commercial vessels thenceforth except after warning them and seeing that passengers and crews were in places of safety. A great diplomatic victory had apparently been won, and America breathed easier.

Meanwhile, German agents were carrying on most surprising plots and intrigues in the very heart of the country. Most shocking of all was the fact that these plots and intrigues were directed by officials of the German embassy in Washington. Men were hired to bring about strikes in American munition factories and to blow up Canadian railways, canals, and tunnels. A number of these men were arrested and sent to prison for their criminal disregard of American neutrality.

The American ambassador in Berlin, James W. Gerard, constantly warned President Wilson of the spirit of hostility to the United States shown by both the Kaiser and his people. Upon one occasion the Kaiser walked up close to Mr. Gerard and speaking very bitterly declared: "America had better look out after this war. I shall stand no nonsense from America after the war." It was clear that the German government would observe its solemn promises to the United States only so long as it suited its interests to do so.

The Germans were using the lull afforded by the *Sussex* pledge to build a large number of new submarines; when they had these ready they confidently believed they could bring the Allies to terms, no matter what the United States did. "Give us only two months of this kind of warfare and we shall end the war and make peace within three months," declared Zimmermann, the German Minister of Foreign Affairs, to Ambassador Gerard, Jan. 31, 1917.

On that same day, Bernstorff, the German ambassador at Washington, suddenly announced that on the following day German ships would again resume the policy of sinking without warning all ships found in the "war zone." Only one exception to this rule was made: America would be "permitted" to send one passenger vessel a week to England provided it was marked in a certain way, pursued a certain course on the sea, and carried no contraband of war.

A flame of indignation went up all over the United States. It became greater when it was learned that Germany had instructed her minister in Mexico to propose an alliance between Germany and Mexico. Germany promised financial support and Mexico was to conquer and retain her "lost territory in New Mexico, Texas, and Arizona." Even Japan was to be induced to join in this hostile scheme.

There was nothing now for the United States to do but to declare war on Germany. The Germans had trampled on American rights on the sea by destroying American property and American lives; they had blown up factories and mills within the United States; they had broken their most solemn promises in connection with the submarine warfare; and finally they had dared to attempt to stir up the Mexicans and Japanese as enemies against the United States.

President Wilson at once called Congress in special session. In a memorable address he stated the difficulties which had confronted the United States since the opening of the European war, and presented the reasons which made war with Germany inevitable.

"We will not choose the path of submission and suffer the most sacred rights of our nation and our people to be ignored or violated," he declared. "We are glad, now that we see the facts with no veil of pretense about them, to fight thus for the ultimate peace of the world and for the liberation of its people, the German peoples included, for the rights of nations great and small, and the privilege of men everywhere to choose their way of life and of obedience. The world must be made safe for democracy.

"It is a fearful thing to lead this great peaceful people into war, into the most terrible and disastrous of all wars, civilization itself seeming to be in the balance. But the right is more precious than peace, and we shall fight for the things which we have always carried nearest out hearts—for democracy, for the

EVERYBODY KNOWS "HOMMES 40, CHEVAUX 8"

When the Americans reached France, their usual conveyance was one of these box cars, which bore signs indicating that they could carry 40 men or 8 horses. The "side-door Pullmans" were always loaded to schedule capacity, and if there was an inch of space left, in went another man. These Marines of the 5th Brigade, just arrived in France, don't seem to object to the new style in railroad coaches; in fact, they genuinely enjoyed it. But they did not ride for long, and only a few weeks later they fought with great gallantry at Belleau Woods, Bouresches, and Château-Thierry.

AT CHÂTEAU-THIERRY, WHERE THE GERMANS WERE FINALLY STOPPED

It was on May 31, 1918, that the Germans reached Château-Thierry in their last advance on Paris. The next day there was desperate street-fighting in the town, in which units of the Third American Division took part. So fierce was the German fire that the French and Americans were quickly driven across the Marne to the south bank. Blowing up the stone bridge behind them, they held the Germans on the other side.

right of those who submit to authority to have a voice in their own governments, for the rights and liberties of small nations, for a universal dominion of right by such a concert of free peoples as shall bring peace and safety to all nations and make the world itself at last free."

Congress and the country received the President's recommendation for war with the utmost enthusiasm. It was to be a war, not for territorial gain, but for the sake of principles long held dear by every American. The nation, therefore, supported the President, and Congress straightway passed a declaration of war, April 6, 1917, in these words:

"*Whereas,* the Imperial German Government has committed repeated acts of war against the Government and the people of the United States of America: Therefore be it

"*Resolved by the Senate and House of Representatives of the United States of America in Congress assembled:* That the state of war between the United States and the Imperial German Government which has thus been thrust upon the United States is hereby formally declared; and that the President be, and he is hereby, authorized and directed to employ the entire naval and military forces of the United States and the resources of the Government to carry on war against the Imperial German Government; and to bring the conflict to a successful termination all the resources of the country are hereby pledged by the Congress of the United States."

Two days after the United States declared war on Germany, diplomatic relations were broken with Austria-Hungary Later in the year President Wilson called the attention of Congress to the fact that Austria-Hungary was "the vassal of Germany" and that the necessities of the war required that she should be considered equally an enemy of the United States. Congress therefore declared war on Austria-Hungary, Dec. 7, 1917.

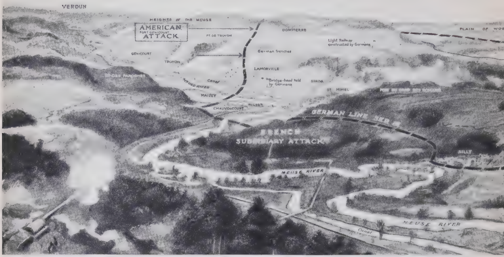
America's Stupendous Preparations

One of the chief reasons why Germany had treated the United States with such contempt was because she knew how poorly prepared for war that country was. It had no army capable of being compared with the vast armies of Europe, few army supplies, and almost no American ships with which to transport either troops or supplies to France. Nevertheless, Congress set to work to pass the necessary legislation for placing the United States on an effective war basis.

Naturally one of the first problems was to raise a huge army. At the outbreak of the war the regular army consisted of 127,000 officers and men. In addition to these there was the National Guard numbering 80,000. Many new recruits at once joined the colors, and thousands more would undoubtedly have volunteered if the President had called for them. After a thorough discussion in Congress, however, it was decided to follow the experience of the Allies and to draft men impartially into the service as they were needed. To this end the Selective Service Act was passed, May 18, 1917. It made all able-bodied men between the ages of 21 and 30 inclusive subject to military service and classified them so that those who had no one dependent on them for a living would be called first. Later the age limit was extended to include all men between 18 and 45.

continued in the Easy Reference Fact-Index at the end of this work

PANORAMA OF ST. MIHIEL SALIENT, CUT BY THE AMERICANS



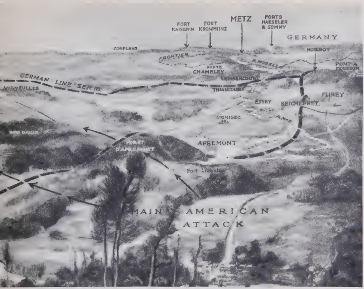
For four years the St. Mihiel salient had been held by the German forces, like a pistol pointed at the heart of France. It was a constant menace to the French, and in their attempts to retake it they lost hundreds of thousands of men. Before the American counter-offensive following the Second Battle of the Marne was half over, preparations were already under way for the first American major operation. The salient had a front 50 miles long, and it was 12 miles deep from its point at St. Mihiel to its base on the line

According to the provisions of these acts over 23,000,000 men were placed at the service of the government. From those in the first draft 687,000 were immediately drawn for service, and the National Guard was filled up to its quota of 450,000. Subsequent calls to service raised the total to over 4,000,000 men. This immense body of men was sent for military training to over 30 large cantonments or camps, which had been hastily constructed in various places. Some of these camps were real cities in extent, and Camp Meade was popularly called "the second city in size in Maryland."

Energetic measures were also necessary to raise the enormous sums of money needed to finance so vast an undertaking. Taxes were extended and increased greatly, so that the total revenue from this source was several times larger than it was before the war. Nevertheless, taxes were entirely insufficient to pay the expenses of the government and it was necessary to ask the people to subscribe to loans. The first Liberty Loan amounting to two billion dollars was enthusiastically subscribed in May 1917. Four later Liberty Loans were subscribed, making the total over 18 billion dollars, not to mention a billion dollars in Thrift and War Savings Stamps bought largely by the school children of the country.

Measures were also taken to conserve the food supply of the United States in order that wheat and other supplies in large quantities might be shipped to aid the peoples in France, Italy, and Great Britain. Herbert Hoover was appointed food administrator, and the enthusiastic way in which people followed the suggestions of the Food Administration showed how thoroughly they believed the slogan "Food will win the war." The production and consumption of coal was also placed under a fuel administrator, Harry A. Garfield, a son of President Garfield. Even the clocks were ordered set ahead one hour during the summer by a "daylight saving" measure designed to save fuel and light. The railroads, telegraphs, and telephones were also placed under direct government operation in order that they might be run as economically as possible and to the best advantage for the prosecution of the war. Everything indeed was done to place the United States on an efficient war basis. It realized what the European nations had already discovered, that war today is no longer an affair of armies and navies merely, but of whole nations industrially organized on a vast scale for combat.

These preparations were not confined to the territories of the United States. If American troops were to be of the greatest use, there must be facilities in France to receive them. Therefore such seaports as Brest and Bordeaux on the western coast of France were practically turned over to the Americans, who deepened the harbors and built huge docks where many ships could be unloaded with ease and speed. Immense warehouses for storing supplies of all sorts were also



IN THEIR FIRST IMPORTANT OFFENSIVE

between Verdun on the west and Pont-a-Mousson on the east. The artillery bombardment started at 1 a.m., Sept. 12, 1918, and at 5 a.m. the infantry went "over the top." After the first hour the attack was a race, punctuated by German rear-guard artillery fire. At 3 a. m. on Sept. 13 American patrols coming from opposite sides of the salient met at Vigneulles. The St. Mihiel salient was wiped out.

erected, and an American railroad with connecting branches—in all a thousand miles long—was built from the French coast to the sector of the western front which the American troops were to hold. The entire equipment, including rails, cars, and engines, was shipped from the United States. Many an American soldier labored in the broiling sun at this humble work, in order that the railway might be quickly completed and the army assured of receiving its needed supplies. The speed and efficiency with which these works were constructed was styled one of the greatest achievements of the war.

All these preparations would have been in vain without ships to carry the American troops to France. The United States had very few ocean-going vessels at the beginning of the war, and so thoroughly were the treacherous German submarines doing their work at this time that Great Britain and the other Allied nations had few ships to lend it. The United States government seized all German and Austrian vessels in American harbors when it declared war, but even so, the supply of available shipping was totally inadequate. So the government, through its Shipping Board and Emergency Fleet Corporation, started in on a stupendous shipbuilding program. Both wooden and steel ships were to be constructed and the existing shipyards were taxed to their capacity. The government built new shipyards, including one at Hog Island near Philadelphia which was the largest in the world. As a result the number of vessels flying the American flag began to increase rapidly. In spite of the terrors of the submarines, it became apparent that the United States would be able to "build a bridge of ships across the Atlantic" to transport and supply its enormous army in France.

The Navy Was Ready

More than any other arm of the government, the navy, to which the safety of this transport across the ocean was entrusted, was ready for immediate action when war was declared. A squadron of American war-vessels under Admiral Sims was at once sent to reinforce the British fleet. Destroyers and smaller vessels known as submarine chasers proved especially valuable in the search for enemy submarines and in patroling the coasts. Owing to the long time needed to construct warships, the chief addition made to the navy in the war was in the form of these lighter vessels for patrol and escort purposes.

The first contingent of American troops reached France on June 26, 1917. A few days later, General Pershing, who had been selected to command the American Expeditionary Forces in France, arrived in Paris. "You have come, God bless you!" said Marshal Joffre to Pershing as he stepped from the train. On July 4, American troops marched through the streets of Paris amid scenes of indescribable joy on the part of the people. That same day General Pershing laid a wreath of American roses on the tomb of Lafayette, and was reported to have uttered these simple but eloquent words: "Lafayette, we are here" (*Lafayette, nous voilà*). The sentiment was that of General Pershing's address, but the words as quoted were spoken by one of his staff officers.

During the first year the number of American troops sent to France was necessarily small. Soon after the opening of 1918, however, the number began to increase by leaps and bounds. It had reached a million by July, and during that month alone 306,000 were embarked. By the middle of November two million American troops were in France, and as many more were waiting in the United States to be sent abroad.

But great as these efforts were, they did not avert many anxious months during 1918. While

AMERICANS IN THE ENEMY'S TRENCHES

On Sept. 26, 1918, the first day of the Meuse-Argonne offensive, units of the 33rd American Division captured this German position, and promptly used it as shelter behind which to fire on the retreating Germans. Here they lay, on the west bank of the Meuse, and fired at the enemy on the east bank, until all preparations were made for a renewal of the advance on Oct. 8. This photograph was made while the actual firing was in progress.

the United States was getting ready in 1917, the French and British had lost power because of battle losses, and the Germans had gained because of Russia's defection, and had the initiative when fighting started in the spring of 1918.

The Final Campaign

When the campaign of 1918 opened, the battle line of the western front ran in a southerly direction from a point on the North Sea near Ostend, past Ypres, Lille, Lens, and Cambrai, to La Fère on the River Oise. From there it bent gradually to the eastward past the battle-scarred cities of Soissons, Reims, and Verdun, and thence to the Swiss frontier. During the winter the Germans made the most elaborate preparations to win a military decision in the west before the full force of the United States could be felt in action. "If the enemy does not want peace," declared the Kaiser in December 1917, after it became evident that France and Great Britain would not accept a "German" peace of submission to his will, "then we must bring peace to the world by battering in with the iron fist and the shining sword the doors of those who will not have peace." This was not an idle boast, because the Germans had just imposed a ruinous peace upon the Russians, which released a huge army of the Kaiser's veterans for service on the western front.

Since 1916 Hindenburg had been the chief commander of the German armies, with General Ludendorff as chief of the General Staff and the real brains of the vast German military organization. On March 21, 1918, the great offensive prepared by these two was launched in the devastated region of the Somme River, with terrific effect. In a few days the German troops overran the entire territory which the British and French had captured with such great labor and cost in lives during the previous summer. They even pushed the Allied troops back of the old lines for a total gain of 35 miles. The Allied losses in prisoners and guns were very large, and the roads of central France were again filled with homeless refugees from the invaded regions. In front of Amiens, however, the Allied troops held fast and thus prevented what threatened to be an overwhelming disaster. The German military clique was filled anew with the arrogance of power. "The prize of victory must not and will not fail us; no soft peace, but one corresponding with Germany's interests," were the words of the Kaiser at this time.

Foch Made Commander-in-Chief

It had been one of the most anxious weeks of the war for the Allies, and it was generally recognized that everything must be done to unify the activities of the Allied troops, in order to prevent if possible a break of the line when the terrible German onslaught should be repeated. It was unanimously agreed, therefore, to make General Foch, now the commander of the French forces, the commander-in-chief of all the Allied armies on the western front—a step which should have been taken long before.

Two days later (March 28), General Pershing, who realized the gravity of the situation, although the American troops were not yet battle seasoned, came to General Foch and said: "I have come to say to you that the American people would hold it a great honor for our troops were they engaged in the present battle. I ask it of you in my name and in that of the American people. There is at this moment no other question than that of fighting. Infantry, artillery, aviation, all that we have are yours to dispose of as you will." So within a short time American troops had an opportunity to take their place in the battle line beside the French and British veterans.

Within a few days, the Germans again attacked south of Arras, where they threw the British back for about ten miles. Then the fighting slowed down for about six weeks. It was only the lull before another storm, which broke on May 27. The scene was the old battleground of the Aisne River, and the Germans were now under the personal command of the Crown Prince, who was put forward to deliver the blow that should crush the Allies and compel them to beg for peace. Like a flood the Germans overwhelmed the French positions between Soissons and Reims. For a week the French slowly retreated, until the battlefront was again on the Marne River at Château-Thierry, only 44 miles from Paris.

The Germans were so elated with their remarkable success that they soon renewed the drive, hoping this time to capture Compiegne, thus placing themselves in position to strike the blow which would deliver Paris itself into their hands. But the French gave only a little ground, and American troops, including two regiments of the Marine Corps, made an imperishable name for themselves at Belleau Wood and Château-Thierry, where by bravery unsurpassed they blocked the way and contributed greatly to saving Paris from German plunder. In honor of the exploits of the American marines the name of Belleau Wood was officially changed by the French government to "Bois de la Brigade de Marine."

Again tempting fate, the Germans started another drive on July 15. They crossed the Marne River in numerous places, hoping to cut the French army in two. But now came the turn of the tide. General Foch had bided his time, saving men and supplies until the fitting moment should arrive for a counter-attack. That moment was now at hand. Troops had been moved up to the right flank of the Château-Thierry pocket, and on July 18 the signal for the Allied

ONE OF THE GIANT GUNS WHICH SUPPORTED THE AMERICANS

This giant gun, manned by men of the U. S. Coast Artillery Corps, is firing 1200-pound shells 18 miles into the German lines from the neighborhood of Nixeville, on the afternoon of Sept. 26, 1918. Many coast artillery and navy guns were mounted on railroad cars, so that they could be quickly hauled to various points back of the fighting lines. So heavy were these guns that they could not have been handled in any other way.

counter-attack was given. The Germans were quickly driven back, and suddenly realized that unless they wished to be surrounded it would be necessary to retreat across the Marne River, which they speedily did, closely pursued by French and American troops.

The most pleasing feature of Foch's offensive was that it did not stop. The large number of American troops now in France and their proved fighting abilities gave him the reserve forces he had formerly lacked. Day after day his attacks continued, both on the western and eastern side of the Château-Thierry pocket. Small "whippet" tanks, used for the first time by the Allies, climbed across German trenches and broke up machine-gun nests. The Germans were totally unable to withstand such an onslaught. They were driven across the Vesle River, and on August 2 the French retook Soissons.

FIRST AID IN THE TRENCHES

First aid is being given to a wounded soldier by men of the Medical Corps of the United States Army. The brassard on the left arm distinguishes the Medical Corps from the Red Cross workers.

Before the Germans could recover from this blow, the British launched a great offensive in the Somme region. Albert and Bapaume were speedily recovered. In little more than a month the Allies took 100,000 prisoners and the Germans were in full retreat on a front of 140 miles between Reims and Arras.

From this time on, General Foch pursued the strategy of striking hard blows in quick succession at various parts of the German line. In two days, September 12 and 13, the Americans assisted by the French blotted out the St. Mihiel salient, which ever since the early months of the war had projected like a wedge into the French lines and threatened the French hold on the fortress of Verdun. Sixteen thousand prisoners and 443 cannon was the toll taken from the Germans in this first great American offensive.

Great Gains in the North

The British, meantime, made great strides in the neighborhood of Cambrai. Even the little Belgian army, assisted by the British, began a drive which in a few days won more territory from the Germans than the British had been able to gain in four months during the previous year. The recovery of French and Belgian towns, including Ostend and other North Sea coast cities, which for four years had been under German domination, now followed in quick succession. Lille fell to the Allies on October 17, and farther to the south the strongholds of La Fère and Laon were surrendered by the retreating enemy.

While the British, French, and Belgians were making these strides, the Americans were undergoing some of the hardest fighting of the war in the Argonne Forest, north of Verdun. The troops of Hindenburg and Ludendorff defended this line with the utmost stubbornness, because it protected their railway communications with Germany. Beginning September 26 and continuing during the month of October, the Americans pushed steadily ahead and had finally reached the railway itself, when the armistice stopping all hostilities was declared, Nov. 11, 1918. At this time the Germans had practically been driven out of France and were retreating all along the line in the utmost confusion. The armistice came at a time when the German army had completely broken down and was entirely incapable of resisting the triumphant progress of the Allied troops toward Germany.

The downfall of Germany had been hastened by the sudden collapse of her three allies on the Balkan and Italian fronts. Bulgaria, the last of these allies to join the German cause, was the first to leave it. For three years an Allied army at Saloniki, composed of miscellaneous detachments of British, French, Italian, and Serbian troops, with a force of revolted Greeks under the Prime Minister Venizelos, had been stationary and apparently useless. It was an army of considerable size, but its commanders hesitated to advance for fear of being attacked in the rear by the treacherous pro-German Greek King, Constantine. But on June 12, 1917, Constantine had been forced to abdicate, and Venizelos was able to bring the whole force of Greece to the side of the Allies. The Serbs especially yearned for the reconquest of their native land. Suddenly, Sept. 15, 1918, the Allied army moved forward, and the Bulgarians, Austrians, and Turks fell back. In less than two weeks the most of southern Serbia had been recovered, and Bulgaria was threatened with invasion. Under these circumstances Bulgaria asked for and obtained, September 29, an armistice in which she agreed to cease hostilities, to demobilize her army, and to surrender all means of transportation in Bulgaria for the use of Allied troops.

After the armistice with Bulgaria, the Serbian army continued its triumphant progress northward. Nish and other cities fell, and the Austrians fled from

A FEW OF THE MILLIONS WHO FOUGHT BACK OF THE LINES

Above (left), men of the Signal Corps are "plotting" the enemy's sector by pasting together photographs taken from airplanes. At the right are bakers at work in their field kitchens, and below is one of the thousands of women who, in mills and factories, replaced the men who had gone to fight.

Albania and Montenegro. Finally, after a campaign lasting less than seven weeks, Serbia was entirely cleared of Austrians and the gallant little Serbian army crowned its successes by the capture of Belgrade, their capital.

A few days after this Balkan campaign began, General Allenby's army, which had taken the city of Jerusalem in the previous December, also resumed hostilities. The Turkish army in Palestine was everywhere overwhelmed. Within two weeks General Allenby captured 71,000 prisoners and advanced 175 miles northward. Historic towns, like Damascus, Acre, Tyre, Sidon, Beirut, and Aleppo fell in rapid succession. The Turkish government was in a panic and hastened to follow Bulgaria by surrendering October 31. The terms of the armistice imposed on her were similar to the Bulgarian conditions. In addition the Turks agreed to open the Dardanelles and Bosporus Straits to the fleets of the Allies, who were also permitted to take over the control of the strong forts which commanded them.

The Italians "Come Back"

More dramatic perhaps than any of these campaigns—certainly far more important—was that begun by the Italians, October 24. For a year the Italian army had apparently lain stunned behind the low banks of the Piave River, across which it had been driven by the mighty offensive of the Austro-German army which began at Caporetto in the previous October. But a new spirit had now been breathed into the Italian ranks; the voice of pro-German and "defeatist" propaganda was stilled and the Italians longed to retrieve the disaster of the previous year. The time seemed propitious because the Germans could lend no assistance, being hard pressed by the Allies in France and Belgium.

The Italians were successful beyond all their expectations. By advancing across the upper Piave, they practically severed the connections between the Austrian troops on the plain and those in the mountains. The Austrians were straightway thrown into a hopeless panic. Within ten days over 300,000 of them surrendered, and the Austrian commander begged for a cessation of hostilities.

The armistice granted to Austria-Hungary, on November 3, required her to demobilize her army, to surrender large strips of territory, to give up one-half of her military equipment and nearly the whole of her navy, to expel German troops from within her borders, and to permit the Allies free use of her railroads. These rigorous terms amounted to unconditional surrender.

The collapse of the Austrian army was accompanied by the collapse of the government at home. The long-expected break-up of the dual monarchy of Austria and Hungary, formed in 1867, came when Bohemia and other parts of the Hapsburg dominions, which for years had longed for freedom, joyfully proclaimed their independence. The heads of the proud and ancient house of Hapsburg, which for centuries had ruled over the destinies of a vast empire, fled to Switzerland for safety.

In Germany, too, defeat after defeat at last had made the people realize that the Kaiser and his militarist "junkers" were responsible for the four long years of battle and bloodshed. Propaganda of the independent Socialists, backed by money and other aid from Bolshevist Russia, had been going on for some time. Disorder broke out in the German fleet at Kiel on November 3, and it spread rapidly to Hamburg and Bremen. The Socialists in Berlin refused to support the government any longer, and rulers of the two important kingdoms of Bavaria and Württemberg abdicated. After hearing of these alarming events the Kaiser himself abdicated at Spa on November 9, and fled to Holland. Everywhere the hereditary princes of the German states resigned their crowns or were overthrown by revolution.

A temporary government was immediately formed at Berlin, which arranged for a national convention to determine the form of the future republic of Germany.

PRESIDENT WILSON'S FOURTEEN POINTS

I. "Open covenants of peace, openly arrived at," and abolition of secret diplomacy.
II. "Absolute freedom" of the seas.
III. "Removal of all economic barriers" and the "establishment of an equality of trade conditions."
IV. Reduction of armament to the "lowest point consistent with domestic safety."
V. "Impartial adjustment of all colonial claims" with equal consideration for the claims of the sovereign state and the interests of the population concerned.
VI. "Evacuation of all Russian territory," and the freedom for Russia to determine her own "political development and national policy."
VII. Evacuation of Belgium and her restoration to full sovereignty.
VIII. Evacuation of French territory and the restoration of Alsace-Lorraine.
IX. "Readjustment of the Italian frontier" along "clearly recognizable lines of nationality."
X: Autonomy for the peoples of Austria-Hungary.
XI. Evacuation and restoration of territory to Rumania, Serbia, and Montenegro; free access to the sea for Serbia; adjustment of the Balkan relations along the lines of "allegiance and nationality"; international guarantees for the independence and territorial integrity of the Balkan states.
XII. Autonomy for alien peoples under Turkish rule and the internationalization of the Dardanelles.
XIII. Erection of a Polish state with access to the sea; its independence and territorial integrity to be guaranteed by international covenant.
XIV. Formation of "a general association of nations for the purpose of affording mutual guarantees of political independence and territorial integrity to great and small states alike."

One month before the Kaiser abdicated, he and his associates realized that all hopes of a successful resistance to the Allies were at an end. The complete collapse of Turkish and Bulgarian resistance and the repeated and staggering blows delivered against the tottering German army in the west could be interpreted in no other way. Therefore on Oct. 6, 1918, the German government informed President Wilson that it accepted the terms of peace which he had outlined in an address to Congress on Jan. 8, 1918—the "14 points"—and in subsequent addresses, and asked him to take steps for a cessation of hostilities.

After some preliminary negotiations, the armistice terms to be demanded of the Germans were agreed on and handed to the German delegates by Marshal Foch. They accepted them at daybreak, November 11. Six hours later, at 11:00 a.m., the guns ceased to fire and peace began to dawn on war stricken Europe.

The terms of the armistice were hard. President Wilson had warned the Germans that they would be such as "to make a renewal of hostilities on the part of Germany impossible." The German army was required to retire to a line about six miles east of the Rhine River, allowing the Allied troops to occupy the evacuated territory together with the three "bridge-heads" of Mainz, Cologne, and Coblenz; to surrender the bulk of the German fleet, including all submarines; to surrender vast quantities of military supplies, including 5,000 cannon, 25,000 machine guns, 5,000 locomotives, and 150,000 railroad cars; to renounce the iniquitous treaties imposed on the Russians and the Rumanians earlier in the year; to surrender all their prisoners; and finally to agree to the principle of reparation for the enormous damage they had done.

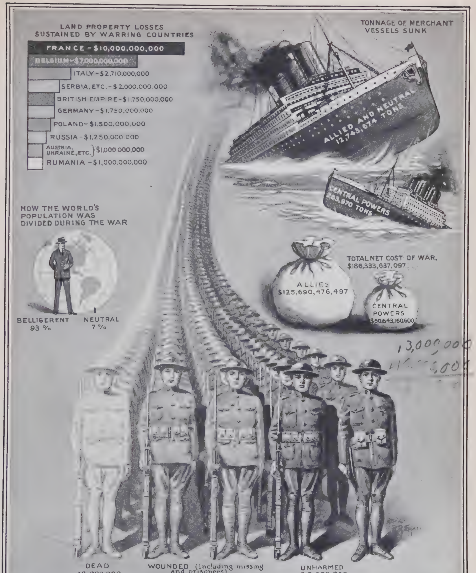
The Peace Congress

The Peace Congress which was to end the greatest war in history assembled at Paris in January 1919. There were representatives from all the countries which had been at war with the Central Powers. In large part the important questions were naturally discussed first by the leaders of the five greatest powers—President Wilson, Premier Lloyd George of Great Britain, Premier Clemenceau of France, Premier Orlando of Italy, and Baron Makino of Japan.

One of the first tasks to which the delegates turned their attention was drawing up a constitution for a League of Nations designed to reduce or abolish the likelihood of future wars. A council composed of the members from the most important countries, and an assembly made up of representatives of all nations admitted to the league were made its governing bodies. Provision was made whereby these bodies should examine international questions and take measures for their solution before nations resorted to war. Secret treaties were abolished. Nations were guaranteed against outside aggression and many small portions of the territory taken from Germany or her allies were turned over to the officials of the League to administer.

The other parts of the treaty with Germany as finally agreed to, required that country to restore the provinces of Alsace and Lorraine, which she had taken from France in 1871; to surrender all her colonies to the Allies for future disposal; to turn over

THE COST OF THE WORLD WAR


LAND PROPERTY LOSSES SUSTAINED BY WARRING COUNTRIES
FRANCE - $10,000,000,000
BELGIUM - $7,000,000,000
ITALY - $2,710,000,000
SERBIA, ETC. - $2,000,000,000
BRITISH EMPIRE - $1,750,000,000
GERMANY - $1,750,000,000
POLAND - $1,500,000,000
RUSSIA - $1,250,000,000
AUSTRIA, UKRAINE, ETC. } $1,000,000,000
RUMANIA - $1,000,000,000
TONNAGE OF MERCHANT VESSELS SUNK
ALLIED AND NEUTRAL 12,743,674 TONS
CENTRAL POWERS 263,970 TONS
HOW THE WORLD'S POPULATION WAS DIVIDED DURING THE WAR
BELLIGERENT 93 %
NEUTRAL 7 %
TOTAL NET COST OF WAR, $186,333,637,097
ALLIES $125,690,476,497
CENTRAL POWERS $60,643,160,600
DEAD 13,000,000
WOUNDED (including missing and prisoners) 20,000,000
UNHARMED 20,000,000

13,000,000

[illegible],000

It may help us to understand what the World War really cost in lives and property if we think of it in terms of things we know. If some great catastrophe had wiped out all the wealth in the United States in 1912—the lands, buildings, railroads, everything—the money loss would have been only a billion dollars greater than the total direct cost of the war, that is, the expenditures for carrying on military operations. If we add the indirect costs—the economic loss from death and injury, loss of production, and property loss—the cost of the war is nearly doubled, reaching the staggering total of $338,000,000,000. If the entire population of the United States in 1830—12,866,020—had been wiped out, the loss of life would not have been as great as that among the soldiers and sailors who fought the World War. If the army of men who were wounded one or more times or taken prisoner had been drawn from the United States alone, it would have taken every man, woman, and child living west of Omaha today. It is only by such comparisons that we can realize what the war really cost.

contained in the Easy Reference Fact-Index at the end of this work

PRINCIPAL BATTLES OF THE WORLD WAR

1914

Aug. 4-16	**The Battle of Liége,** a fortress on the Belgian frontier. Here was heard the first roar of hostile artillery in the Great War. The determined stand of the Belgians upset the enemy's program and made the German army ten days late in reaching the French frontier.
Aug. 21-23	**The Battle of Mons-Charleroi,** in Belgium. The combined forces of the French and British were defeated by the Germans, whose path into France was now open.
Aug. 26-Sept. 1	**The Battle of Tannenberg** in East Prussia, called by the Germans the "Sedan of the East." Hindenburg here crushed one of the Russian armies that had invaded East Prussia.
Sept. 6-10	**First Battle of the Marne.** One more decisive battle of the world. The Allied troops under Joffre and Foch stopped the German advance within sight of Paris and turned it into a German retreat.
Sept. 6-10	**The First Battle of the Mazurian Lakes,** in East Prussia, resulted in the crushing of the second Russian army by the Germans and the making of Hindenburg the idol of the German people.
Sept. 12-17	**The Battle of the Aisne** began the trench warfare which lasted until 1918.
Oct. 16-28	**The Battle of the Yser River** in Belgium; the Belgians halted the German advance by cutting the dikes and turning the country into a lake.
Oct. 22-Nov. 15	**The First Battle of Flanders,** or as it is sometimes called, the **First Battle of Ypres** (a city in Belgium). The Germans failed in their attempt to pierce the lines and reach Calais.
Nov.-Mar. 22	**Siege of Przemysl,** a strong Austrian fortress in eastern Galicia. 120,000 Austrians were made prisoners when hunger forced its surrender to the Russians. The fortress was retaken by the Austrians and Germans on June 2, 1915.

1915

Jan. 24	**The Battle of Dogger Bank,** a naval engagement in the North Sea between battle-cruiser squadrons of the British and Germans. The German vessels finally retired to the mine-strewn German waters, leaving the victory to the British.
Feb. 4-12	**The Second Battle of the Mazurian Lakes;** like the first, it ended in disaster for the Russians.
Mar. 10-12	**Battle of Neuve-Chapelle,** a little village in northern France, near Lille. The British captured a few miles of territory at a terrific cost; as much ammunition was expended in this one battle as was used during the entire Boer War.
Apr. 22-26	**Second Battle of Flanders, or the Second Battle of Ypres.** The Germans for the first time used the poison gas (chlorine), through pipes and bombs. In spite of the heroic behavior of the Canadians the Germans gained two miles on a five-mile front.
Apr. 26-Jan. 8	**Invasion of Gallipoli,** the peninsula between Dardanelles Strait and the Aegean Sea. After months of blundering the British forces, made up largely of colonial troops (Anzacs), and the French army were withdrawn with nothing accomplished.
May 2	**Battle of Dunajec River** in western Galicia, Austria. The Austrian and German troops forced back the Russian line, taking many prisoners. This was the beginning of the terrific drive which expelled the Russians from Galicia and conquered Russian Poland (July 12-Sept. 18).
Sept. 25-Oct.	**Battle of Champagne and Flanders,** begun after several days of heavy bombardment. The desperate offensive of the French, British, and Belgians resulted in some advance and many prisoners taken, but it failed to break the German lines.

1916

Feb. 21-July	**Battle of Verdun,** a fortified city in eastern France. This was one of the greatest battles of the war. The German Crown Prince sacrificed 500,000 men in the vain attempt to take the city.
May 31	**Naval Battle of Jutland,** in the North Sea. The British lost six capital ships and 6,274 men killed and wounded, against two capital ships and 2,545 men lost by the Germans, but remained in control of the sea.
July 1-Nov. 15	**Battle of the Somme River** in northern France, one of the bloodiest battles of the war. The French and British, using "tanks" for the first time, drove the Germans back nine miles on a 20-mile front.

1917

May-Oct.	**Battle of the Isonzo River,** at the head of the Adriatic Sea, began by a drive of the Italians against the Austrians and Germans. In October the Austrians began a counter-offensive by the surprise attack at Caporetto, which resulted in terrible rout. The Italians were driven back to the Piave River and lost all that they had gained in two years, besides 200,000 prisoners and 2,000 cannon.
July-Dec.	**Third Battle of Flanders,** or, as it is sometimes known, the **Third Battle of Ypres,** (Passchendaele Ridge) was a slight gain for the British, French, and Belgians over the Germans.
Nov. 20-Dec. 13	**Battle of Cambrai,** a city of northern France on the River Scheldt, was begun by the British and French tanks without any artillery preparation. The gains that were made at first were lost in the German counter-attack.

1918

Mar. 21-Apr. 21	**Battle of Picardy and Flanders,** on the west front from near La Fère to Ypres and beyond, began the German offensive in 1918, and proved to be one of the "greatest and most momentous battles in the history of the world."
May 27-June	**Second Battle of the Aisne,** a second success for the Germans over the British and French. When they were within about 40 miles of Paris, however, they were stopped by the French and the Americans at Château-Thierry.
July 15-18	**Second Battle of the Marne** resulted in some gains by the Germans, but their plans were suddenly upset by the counter-offensive of the Allied troops under Foch.
Aug. 8-Sept.	**Second Battle of the Somme,** a great gain for the British, French, Belgians, and Americans. The operations spread until the Germans were pushed back beyond the Hindenburg line.
Sept. 12-13	**Battle of St. Mihiel,** the first battle in which the Americans acted independently. As a result of the battle the salient which had been held by the Germans since 1914 was wiped out.
Sept. 19-22	**Battle of Samaria,** resulted in the annihilation of the Turkish troops by the British and Arabs under General Allenby. Turkey soon withdrew from the war.
Sept. 26-Nov. 11	**Battle of Argonne Forest.** After the Americans had cleared the Lorraine sector by the battle of St. Mihiel, they were transferred to the Argonne Forest, which in hard fighting they took from the Germans. This was a part of the battle which was raging all along the western front and which caused the collapse of the German military machine.
Oct. 24-31	**Battle of the Piave.** This removed Austria from the war and led her to ask for peace because her army had been completely routed.

the province of Posen in Eastern Germany to the new republic of Poland; to reduce her standing army to 100,000 men; to maintain only a small navy with no submarines; to surrender nearly all her merchant ships as partial payment for the shipping sunk by her submarines; to deliver large numbers of horses, cattle, and sheep to France and Belgium in repayment of stock carried off by her armies; and finally to make financial reparation for other damages done during the war, the amount of this reparation to be determined later by a special commission. The sinking by the German commander of the fleet surrendered to the Allies after its delivery to the British at Scapa Flow, later added a new item in the bill for damages.

When the treaty was finally completed, the Germans were notified to send delegates to Paris to receive it. In the same hall at Versailles where the Germans had humiliated the French by proclaiming the German Empire in 1871, the treaty was handed to the head of the German delegation, May 7, 1919. The German delegates made the most strenuous objections to the rigorous terms, including especially the provisions regarding financial reparation and the surrender of their merchant vessels, but the Allies made only slight concessions. "There must be justice," they declared, "for those millions whose homes and lands and property German savagery has spoliated and destroyed. This is the reason why the Allied and associated powers have insisted, as a cardinal feature of the treaty, that Germany must undertake to make reparation to the very uttermost of her power." Finally on June 28, 1919, exactly five years after the Austrian Crown Prince had been murdered, the German delegates affixed their signatures to the treaty which was to end the World War.

"HEY, BUDDY, LOOK AT THE STATUE OF LIBERTY!"

What a riot of joy! It is the enthusiasm of 3,000 men aboard a great army transport, glad to see the familiar landmarks which spell home, family, and friends. The war is forgotten. All the dirt, discomfort, suffering, victory even—all are forgotten in the joy of being home again.

In the meantime a treaty with Austria was arranged and was handed to the Austrian delegation, June 2, 1919. The head of the Austrian delegation, on receiving the treaty, addressed the Peace Conference in French instead of German, and declared that the new Austrian republic was free "from the horrible crime" of starting the war of 1914. He hoped thus to induce the Allies to modify the terms. The Allies made a few concessions but in the main the Austrians suffered a severe punishment for their part in the war. The provisions of the treaty reduced Austria to a small country with six or seven millions of people. It required her to recognize the complete independence of Bohemia, Hungary, and the Southern Slavs; to cede large districts including most of her coast line to Italy, with a good part of Hungary to Rumania; and to make reparation for the damage done during the war. The Austrian delegates signed the treaty at St. Germain, Sept. 10, 1919.

Later treaties fixed the new boundaries of Turkey and Bulgaria. Bulgaria did not suffer greatly in loss of territory, but much of the former Turkish Empire including Palestine, Mesopotamia (Iraq), Smyrna, and part of Syria was turned over to the Allies, to be administered by them as "mandataries" of the League of Nations.

Various disputes protracted the exchange of ratifications, so that it was not until Jan. 10, 1920, that the German treaty was declared in force and the blockade of Germany was definitely ended. Even then China and the United States were not included among those nations making peace with Germany. China objected to the cession to Japan of the rights previously held by the Germans in the Chinese province of Shantung. In the United States, owing to a dispute which broke out between the majority in the Senate and President Wilson, that body rejected the act ratifying the treaty Nov. 19, 1919 and March 19, 1920. The chief point in dispute involved the question of reservations to be made concerning the entrance of the United States into the League of Nations. The question was threshed out before the people of the United States in the presidential election during the autumn of 1920, and resulted in the election of the Republican candidate, Warren G. Harding, as President, with an overwhelming majority of Republicans in Congress. During the special session of Congress called shortly after the new administration came into office a resolution was passed by Congress and signed by the President (July 2, 1921) declaring the state of war between the United States and Germany and Austria-Hungary to be at an end. The United States then concluded separate treaties of peace with Austria and Germany, which were signed Aug. 24 at Vienna and Aug. 25 at Berlin.

New Little Wars after the Peace

Even after the signing of the treaties, to bring about actual peace in all parts of Europe did not prove an easy matter. Italy insisted on having the entire eastern coast line of the Adriatic Sea, including the port of Fiume, which was also claimed by Jugo-Slavia, a new country formed by the union of Serbia and Montenegro with the Slavic people of the southern and western parts of the former Austro-Hungarian monarchy. For a time an Italian filibustering expedition led by the poet-aviator D'Annunzio held the city and threatened a new war; but later (Nov. 12, 1920) the two countries settled their differences by agreeing to make Fiume an independent city and ceding to Jugo-Slavia some of the territory in dispute.

In Russia the Bolshevik government busily waged war on the several counter revolutionary movements in southern and eastern Russia, while defending itself against the armies of the new Polish republic on the western front. General Wrangel's army, the last serious opponent of the Bolsheviki at home, was crushed in the Crimea in November 1920. In the meantime the Poles drove the Bolshevik army back into Russia; following this the Russians signed a treaty (March 18, 1921) in which they agreed to pay Poland an indemnity of 30,000,000 gold rubles (normally $15,450,000) and to cede to Poland a great stretch of border territory. The smaller states lying on the Baltic Sea were also recognized by the Bolshevist government.

In the meantime the French had trouble with the Arabs over Syria. The Greeks, who had restored their king Constantine in defiance of the Allies, warred with the Turks to obtain territorial gains promised in the peace treaties, while the Allies remained neutral and the Bolshevik government supported Turkey. The Poles openly defied the peace treaty by occupying nearly all of Silesia, which by a considerable majority voted under the treaty (March 20, 1921) to remain with Germany. The Japanese occupied Vladivostok and other parts of eastern Siberia; while the American government refused to recognize the mandate giving Japan the island of Yap. After long negotiations Germany's indemnity was fixed (May 1921) at 135 billion gold marks (normally $32,130,000,000).

But even then disputes continued. Germany's finances went from bad to worse; and by December 1923, it seemed that reparations payments would cease. France and Belgium thereupon (January 1924) seized the Ruhr Valley with its rich mines and factories.

This all but paralyzed both German industry and power to pay; and gradually all parties realized that some compromise must be reached. Accordingly (November 1923) a committee of experts, headed by Charles G. Dawes of the United States, was created to consider reparations. April 9, 1924, this committee recommended measures to stabilize German finances and insure reparations payments, the total to be determined when Germany recovered stability, with fixed payments meanwhile. This report was accepted August 31, 1924, and settled the reparations question.

The remaining difficulty—France's fear that Germany would renew the war when able—was settled by negotiations culminating in the treaties drawn at Locarno, Switzerland, and ratified in London, December 31, 1925. The first bound France, Germany, and Belgium to respect the Rhine frontier as fixed by the Treaty of Versailles. Great Britain and Italy agreed to help enforce it. Others provided for arbitration of disputes between Germany and France, Belgium, Poland, and Czechoslovakia. France also guaranteed the Polish and Czechoslovakian treaties. All these treaties were to be under supervision by the League of Nations, which Germany was to join as an equal member. Thus, seven years after the armistice, the World War finally was settled and true peace in Europe seemed at hand. (*See also* articles on battles, statesmen, and commanders).

WORMS. All long, narrow, creeping, or squirming lower animals are "worms" according to general popular conception. We speak of earthworms, tapeworms, "cutworms," "cabbage worms," "wireworms," and many others. Only the first two of these, however, are true worms, the others being the early stages or larvae of moths, butterflies, and beetles. Earthworms and their relatives belong to the higher or ringed worms (*see* Earthworms).

The lower worms—the *Vermes* of the zoölogist—as treated of here, include about 9,000 known species or kinds of extremely diverse animals that are often divided among a half-dozen independent branches of the animal kingdom. Among them are a thousand shapes and sizes. Many are long and worm-shaped; but many of them also are short and flat, while some look more like seaweeds, and some have bivalve shells. Some are invisible to the naked eye; some of the tapeworms are 30 feet long.

Among them are also a thousand places and modes of life. Many of them live in fresh or salt water, in the soil, or in decomposing organic matter. A majority are parasites in a great variety of animals and some plants. They lead strange lives, and some of them have the most curious and wonderful life histories of all animals. Many of them cause diseases of man and domestic animals and plants. In most cases the injury is but slight. They are soft-bodied, except one group (the Brachiopoda) that have bivalve shells, and another group (the Bryozoa) that look more like seaweeds. The *flatworms* and *roundworms* are of greatest interest and practical importance, and will be treated of more fully.

The flatworms are oftenest leaf-shaped, though the tapeworms are long and narrow. Except the tapeworms, flatworms have a mouth, but no intestinal opening; waste is discharged through the mouth. A majority are parasites and show strikingly the degeneracy resulting from their parasitic life. A tapeworm of man, for instance, lives in the intestine surrounded by digested foods, ready for its absorption. It no longer has to "hustle" for itself, and so has lost its organs of special sense, its organs of locomotion, even its mouth and digestive system. Parasites are also oftenest hermaphrodite, that is, bear both male and female sex cells.

Remarkable History of the Liver Fluke

The liver fluke illustrates well the mode of life and wonderful histories of the flukes. It lives in the gall passages, oftenest in the sheep, but also in cattle, rarely if ever in man. It is leaflike in shape, about an inch or two long, a half-inch wide. When a hundred or more of them infest a sheep they cause liver rot and death of their host. Formerly, especially in Great Britain and Ireland, millions of sheep were lost in bad years. The life history is so surprising that one would not believe it possible if scientists had not worked it out with great ingenuity and patience, and with very great benefit to sheep raisers. Each full-grown worm produces about a half-million eggs which pass out of the sheep's body with the intestinal waste. If an egg falls into water of the proper temperature, it hatches out into a kind of tiny microscopic larva which swims about and bores its way into the soft body of a certain kind of common pond snail. Here it grows and forms on its inside a dozen or two larvae of a second type; each of these, still inside the snail, produces a dozen or two larvae of a third kind, tadpole-shaped. These break out from the snail, swim about, and cement themselves to blades of grass which are eaten by sheep. They pass from the intestine up the gall passages and, in a few months, grow to full size. Amazing as is this life history of the liver fluke, it becomes still more complicated under certain conditions. Fortunately, liver flukes are found in only a few limited localities in the United States—parts of Texas, Florida, etc. Drainage of marshy places and other devices are effective in killing the snails and getting rid of the flukes. There are about 2,500 known kinds of flukes, all parasites in many kinds of animals. About a quarter are external parasites of water animals, mostly fishes, and have but a single host. Some of them have even three hosts in their life history. The liver fluke just described is the only very bad one.

The History of the Tapeworm

The commoner "beef tapeworm" of man will typify the several thousand kinds of tapeworms that infest almost all of the backboned animals of all kinds. It lives attached to the inside lining of the small intestine. The name suggests its general form. It is soft, whitish, narrow, and very long—up to 30 feet in very large specimens. The "head," about the size of a large pinhead, has four suckers for attachment to the intestine. Back of the head is the "neck," in size and form much like grocer's twine. It gradually enlarges away from the head, and becomes jointed till the larger free end is composed of joints over a half-inch long and a quarter-inch wide. The joints are maturing all the time and are cast out, singly or a few at a time, with the intestinal waste. Each bears both kinds of sex cells and is really an animal, so that a tapeworm really seems to be a chain of more than a thousand animals. The eggs enter cattle by water or food and hatch into tiny larvae which burrow through the wall of the intestine to the blood stream. They pass to the muscles where they grow into bladder worms, coiled up and about the size of a pea. The presence of these gives the name of "measly beef" to the meat. This meat, improperly cooked, infects man. The little worms attach themselves and grow to full size in a few months. One large worm would seem to be bad enough, but sometimes there are two of them. Other tapeworms of man are the "pork tapeworm" about 9 feet long, from eating measly pork, and the "fish tapeworm," from measly fish, up to 25 feet long. The two last are found mostly in Europe, seldom in the United States. Other kinds of tapeworms, some of them in man, have life histories even more striking but more difficult to understand.

A person treated for tapeworm fasts for a day; then takes some poison that causes the worm to loosen its hold, followed by castor oil to sweep the intestine clear. It is necessary for the head of the worm to be loosened, otherwise the whole worm will grow again. Tapeworms are really not of much danger, for they are not frequent, and a person has but slight chance of becoming infested.

The names "threadworms" and "hairworms" for different kinds of roundworms suggest their long narrow form. They move by squirming; are oftenest a whitish color; never jointed; vary in size from a hundredth of an inch long to more than a yard; are of separate male and female sexes, the female almost always being the larger; and the young are often born alive. Several thousand species are known. Many of them live in water of ponds and streams, or in the soil of gardens, or in decomposing organic matter. Most of them, however, are parasites which live in all sorts of backboned animals, and in many of the lower animals, especially insects of many kinds. They are the commonest parasitic worms of man and domestic animals. Many of them pass their early life in one host and their adult life in another.

Only a brief account of a few of the most interesting and important forms can be given here. The tiny "vinegar eel" may typify the free-living form. It is about a twelfth of an inch long and grows in vinegar and other fermenting fruit juices. Surprising forms are the "hairworms," five or six inches long, that live coiled up in the bodies of grasshoppers, caterpillars, and other insects. The "horsehair worms," a foot to a yard long, also develop in insects. They break out, sometimes in horse troughs and streams, and give rise to the mistaken notion that they come from horsehairs. Of course no one has ever really known of a horsehair turning into any living animal!

Among the strangest of the life histories are those of the *filarias*. This worm is conveyed to man by mosquitoes, much as malaria germs; it is three inches long, and a hundredth of an inch in diameter. It is one of the causes of "elephant skin" or elephantiasis in man, in which a leg may grow almost as large as the rest of the body. Another filaria, the "Guinea worm," is a yard long, lives coiled up in the skin, and enters the body through fleas in drinking water.

Cause of the Dread Trichinosis

The disease trichinosis of man is caused by a small worm (*trichina*) a tenth of an inch long. The natural home of the full-grown worm seems to be in the intestine of the rat. Eaten by pigs, the young hatch out and pass in the pig's blood stream to its muscles, where they develop into "encysted" or coiled-up larvae, ready to be eaten by man. Poorly cooked pork passes them alive to man, where they develop rapidly in the intestine; and the young then pass to the muscles, and become coiled up, sometimes by millions. Only the smaller part of cases of trichinosis result in death. Government inspection of pork makes the danger of infection very slight.

One of the most notorious of the roundworms is the "eelworm" so prevalent among children, but found also in pigs, as a parasite of the intestine. Infection is from water, fruit, etc. It grows to be 8 to 12 inches long. The eggs pass out with the waste, and develop in the water or soil, ready to infect other people. Very similar is the "mawworm," from the intestine of the horse; when abundant it has been known to cause death.

The worst of all the worm parasites of man—among the greatest of the enemies of mankind—are the two species of "hookworms" so prevalent in warmer countries. They infest perhaps a quarter of mankind at the least (*see* Hookworm).

They Might Be Much Worse!

These are just a few of the many interesting and important worm parasites that infest man and domestic animals. While the number is very large, and their injury sometimes great, it is comforting to know that most of them are local in their distribution and unusual. None of them except hookworms compare in importance with the worst of the microscopic disease germs, both plant and animal. Almost all may be easily avoided by proper habits of life—clean surroundings; clean, dry, light houses; proper care of the water supply; proper cooking of foods. Civilized man, leading a hygienic life under sanitary conditions, is seldom attacked.

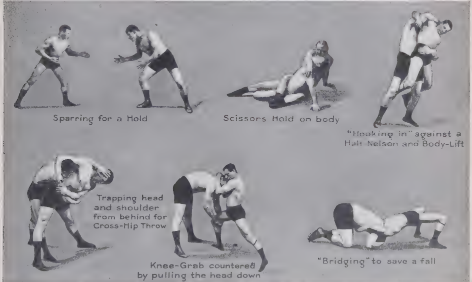
The "worms" as a general term include both the lower worms treated of in this article, and the ringed or segmented worms or *Annelida*. The *Vermes* of the scientist—the "worms" as used here—is sometimes considered one of the great branches of the Animal Kingdom; but it is oftener broken up into four or five minor branches of animals. (*See* chart accompanying Animal Kingdom.) The *Rotifera*, or "wheel animalcules," are small microscopic forms, the largest of the thousand known species being not over a twelfth of an inch long. They hook themselves fast by a pair of hooks, and have a "wheel" of cilia around the free end, whence the name "wheel animalcules." They are mostly fresh-water forms and are among the most omnipresent and fascinating of the many kinds of "animalcules" for microscopic study. The *Bryozoa* or "moss animals" look much like seaweeds and mostly live as colonies. They are found as very ancient fossils, and as living forms in both fresh and salt water; some fresh-water types form large jelly-like masses, a foot in diameter. The *Brachiopoda* or "lamp shells" are attached, marine, mollusk-like worms, with a bivalve shell. The two valves are not right and left as in a clam, but upper and lower. These forms evolved early in the world, and all of the almost 3,000 known species are fossil, except about 120 species. Some of the living kinds are among the oldest known animals, for they have remained practically unchanged since early geological times—for many millions of years.

Wren. "The little chattr'n sassy wren, no bigger'n my thumb," as 'Darius Green' characterized her, is the world-wide busybody. Her large family appears in over 250 different species, but always as small birds in quiet grayish-brown feathers. The sexes are alike, not only in dress but also in manner. They are never quiet and usually appear nervously excited, with tail carried erect and shining eyes spying into every corner. When displeased the wren utters a loud insistent scolding call, which can instantly change to a ripple of a song.

The many species build similar dome-shaped nests in trees or rock-cavities or in nooks about a barn or house. The white or pinkish spotted eggs are from 6 to 11 in number, and as each pair of wrens rears two families each season, the parents are necessarily great foragers and take heavy toll of garden insects.

All wrens are famous singers. No member of the family has been accused of harm to man, and no wild birds live on more intimate terms with their human neighbors. About 28 species are found in the United States. Of these the house-wren is best known. (For illustration in colors, *see* Birds.) The marsh wren is remarkable for his night song which on moonlight nights may be heard from dusk till dawn. The scientific name of the wren sub-family is *Troglodytidae;* it includes, in addition to the wrens, the mocking-birds and thrashers. Scientific name of common house-wren, *Troglodytes aëdon.*

EXPERT WRESTLERS DEMONSTRATING SOME TRICKS OF THE SPORT


Sparring for a Hold
Scissors Hold on body
"Hooking in" against a Half Nelson and Body-Lift
Trapping head and shoulder from behind for Cross-Hip Throw
Knee-Grab countered by pulling the head down
"Bridging" to save a fall

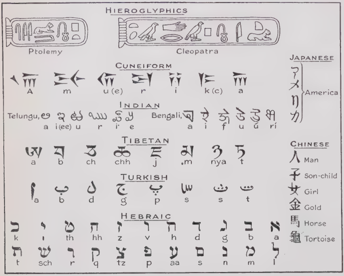
Here you see some of the fundamental wrestling "holds" and positions. Wrestling is a vigorous indoor sport. It exercises practically every muscle in the body, and trains the eye and the body to function quickly. Skill and quickness are often more than a match for greater strength. Wrestling, as distinguished from rough-and-tumble fighting, is a scientific pastime, and requires study and careful practice, just like boxing and fencing.

Wrestling. "A boy's most natural sport" is a fair description of wrestling. Almost every boy takes to the sport instinctively, as his early tussles with his brothers or his young playmates give evidence. As he grows older he finds that there is science in wrestling, and that if he masters even some of the simpler holds, he can throw opponents who are larger and stronger but less skilful than he. It is an excellent exercise, involving all the muscles.

There are almost as many styles of wrestling as there are nations, but among the English-speaking peoples the "catch-as-catch-can" is the most popular. It allows unlimited action, which includes struggling on the ground, tripping, catching hold of legs, and similar tactics. At the beginning of a wrestling match the two opponents face each other, and at the signal to begin each tries to secure a hold that will enable him to throw his opponent to the ground in an advantageous position. A throw consists in forcing both of the opponent's shoulders to the ground. Some of the holds are the half-, three-quarter-, bar-, and locked half-Nelsons, used simply or combined with leg holds. In recent years the "scissors" hold, which consists in getting an opponent between one's legs and then crossing the ankles and locking the feet, has come into favor. The "flying mare" is a spectacular means of throwing an opponent. It consists in seizing his wrist, turning quickly, and swinging him over your back with a sudden jerk.

The French or Graeco-Roman style differs from the catch-as-catch-can by forbidding tripping and catching hold of legs. In Ireland the national style of wrestling is the "collar and elbow" method, in which the two opponents seize each other with one hand on the neck and the other on the elbow.

WRITINGS IN MANY LANGUAGES



The earliest form of writing is picture-writing, in which signs are used to represent words, just as we use the sign $ to mean "dollar." In the Egyptian hieroglyphics, shown at the top, these signs have been conventionalized, each representing a single letter. Thus the group at the left spells "Ptolemy" and that at the right "Cleopatra." The Chinese never took this important step from picture-writing to alphabetic writing. They still represent every word or syllable by a single character, as you see in the lower right-hand group. The Japanese use characters, similar to the Chinese, for each syllable. Thus four characters, which read from top to bottom, are used to write "America." To the left of the Japanese writing you see how "America" is written in the ancient cuneiform writing of Babylonia, in which groups of wedge-shaped signs have taken the place of the older picture-signs. Below are specimens of writing in other Asiatic tongues. Notice that the Hebrew is read from right to left.

In Japan ju-jutsu is a popular form of wrestling, in which there are a great number of holds and swift movements that aim at disabling an opponent. When carried to its extreme, as in a serious struggle to defend one's self, it includes dislocating joints, breaking bones, paralyzing the nervous system, and in fact may bring death to an opponent by various secret methods known only to the most experienced practicers of the art.

WRITING. Early man invented writing when he first began to use signs and symbols in place of pictures to record his successes in war and the hunt, or to show the tribute due from subjects to their lord or king, or to identify valuable personal belongings, such as weapons, tools, pottery, and the like, by means of marks which were recognized as the sign or autograph of a particular person. The need of records for religious and government purposes, for communicating with distant agents or correspondents, and in carrying on trade, all helped to develop this invention, which is now so universally used that the wonder of it has ceased to move us.

Time and number were easily indicated by knots in cords and notches in sticks (*see* Incas), and gradually various kinds of information were conveyed by means of rough drawings of natural objects on skins, bark, wood, bone, clay, and stone. When America was discovered, the Indians had progressed so far in this art of ideographic or picture-writing that they were able to record events and to express such abstract ideas as war and peace with colors and symbolic designs. This picture-writing sufficed for the limited thought and simple needs of primitive tribes. In Egypt and Babylonia this stage was reached as early as the year 4000 B.C.

The ancient peoples of the Old World, who reached a high degree of civilization, required such a vast number of "ideographs" to express their complex life that the method of picture-writing became cumbersome and confused. The Egyptians, Babylonians, and Chinese took the next step by conventionalizing the picture. For instance, they represented a bull by his horns, an eye by a circle with a dot in the center. Then the signs were regarded as representing spoken sounds or syllables, and might be combined to represent other things of which it was difficult to make a picture. Thus, to illustrate by using an English example, the symbol for a *bee* might be joined to that for a *leaf* and so give the written sign for the abstract word *belief*.

This sort of writing is known as hieroglyphic writing. It is best represented by the ancient writings of Egypt, chiseled in stone or written with a pen or brush on paper made from the papyrus plant. It is interesting to note that the Mayas of southern Mexico, the most advanced of American Indians, had developed the art of writing up to this point before they were destroyed by the warlike Aztecs. As a literary medium the hieroglyphic writing is not to be despised. It expressed the varied culture of the Egyptians and Babylonians, and in it the Chinese have preserved their numerous writings, including those of the ethical philosopher Confucius. Chinese writing has never advanced beyond this stage. Today the pictorial characters of the written language are still painted with brushes, just as in ancient times when there were no pens or pencils. The Babylonians, writing with a wedge-shaped stylus on soft clay tablets (which were afterward baked), developed a system of wedge-shaped characters called cuneiform writing. In many cases the development of the cuneiform characters from the Egyptian hieroglyphs can be distinctly traced.

The invention of the alphabet, the next step in the history of writing, was probably first made by the Egyptians as early as 3000 B.C. Instead of syllables, the spoken language was reduced to a small number of separate sounds, each represented by a letter; by combining these letters any word could then be represented. This invention greatly simplified writing, and today nearly all peoples write and print in alphabetic characters. (*See* Alphabet.)

Hundreds of different kinds and styles of alphabetic writing have been used among different peoples and at different times. Hebrew, Turkish, Arabic, Greek, and Russian printing and writing still flourish alongside our characters, which are derived from the Latin. The oldest Latin manuscripts and inscriptions were written entirely in capital letters. During the Middle Ages the old monks spent months in producing a beautifully written parchment book or manuscript, "illuminating" it with pictorial initials and chapter headings. Even in our own country styles of writing have changed at different times, so that we can easily distinguish the handwriting of Washington and Jefferson's day from the Spencerian, vertical, or modified slant of later school exercises. (*See* Handwriting.) In the Semitic languages (Arabic, Hebrew, etc.) the writing is from right to left instead of from left to right.

BABYLONIAN TABLET

This black memorial stone is inscribed in Babylonian cuneiform characters and gives an account of the restoration of the walls and temples of Babylon by Easarhaddon, king of Assyria.

WYCLIF *(wĭk′lĭf)*, JOHN (about 1320–1384). Almost six centuries ago an English priest stood on trial before the archbishop of Canterbury and the bishop of London. A tall figure, clad in a simple black gown, pale and thin, with keen, sharply cut features that bore the marks of earnest study and of self-denial, he faced his accusers with clear and penetrating gaze, and spoke firmly and resolutely in answer to their charges. This clergyman was John Wyclif, the learned Oxford scholar and teacher, called to account for criticizing the church.

At that time the pope—or rather the popes, for it was the time of the Great Schism and there were two—were asserting their power in temporal affairs and burdening the people with taxes five times as heavy as those exacted by the king. Wyclif protested against this and against the evil and worldly lives of the clergy. Moreover he declared that every man was responsible directly to God, and that the Bible, not the church or tradition, was the supreme authority. He emphasized more and more the superior power of the king in civil affairs.

It might have fared hard with this defiant clergyman, whom his enemies called "John Wicked-believe," but the people, who had learned to love him for his kindness and the holiness of his life, came to his rescue. A crowd of London citizens appeared upon the scene and caused such a commotion that Wyclif was allowed to go, with a warning to be careful what he preached.

But Wyclif was supported by John of Gaunt (who was the power behind the throne) and by the great nobles, so long as he denounced rich churchmen. So he continued to preach as fearlessly as ever, though the pope himself issued bulls or papal decrees against him, and his teachings were condemned at the University of Oxford. "I believe in the end the truth will conquer," he declared. He sent out "poor priests"—Lollards they, like all his followers, came to be called—who, dressed in coarse russet gowns and carrying staves, traveled throughout the country calling men back to faith in the simple gospel of Christ.

Wyclif lost the support of the great nobles after the Peasant's Revolt in 1381. His teachings that lordship and property were held only by God's grace and were forfeited if the holders fell into mortal sin had contributed not a little to this movement. In order that the people themselves, among whom he found his most faithful supporters, might be able to read and understand the Bible, his followers made the first full translation of it into English (1382). To this important work Wyclif's name was attached although his direct part is a matter of uncertainty. Not only did this translation have a tremendous influence on the lives of the people, but it set the standard of their language, and earned for Wyclif the title of "the father of English prose."

Wyclif has been called the "Morning Star of the Reformation." Although he died without having brought about any great change in the church, his teaching had a powerful influence on John Huss, the Bohemian reformer, and through him on Martin Luther, the leader of the great Reformation in the 16th century. (*See* Reformation, Protestant.)

In the HEART *of the* WEST — *Rugged* WYOMING

Jackson Lake in Western Wyoming, 6,800 Feet above the Sea

Extent.—North to south, 276 miles; east to west, 370 miles. Area, 98,000 square miles. Population (1925 census), 206,381.

Natural Features.—Rocky Mountain system, including the Laramie and Medicine Bow ranges in the southeast, the big Horn Mountains in the north, Absaroka, Owl Creek, Wind River, Teton, and Salt River ranges in the west (highest peaks, Gannett and Fremont Peaks, nearly 14,000 feet). Great plains rolling east from the mountains, broken by the Black Hills of South Dakota in the northeast. Principal rivers: Big Horn, Powder, North Platte, Green, and Snake. Yellowstone National Park.

Chief Products.—Coal and petroleum; hay, wheat, oats, and potatoes; lumber and timber products; sheep, wool, and cattle.

Principal Cities.—Cheyenne (capital, about 14,000), Casper (24,000).

WYOMING. It would require all New England and Indiana to make another Wyoming—a state whose grazing land is equal to the entire area of Kentucky; whose farms exceed in size Massachusetts and Connecticut combined; whose forests cover more territory than the states of Maryland and Delaware; and whose extensive coal and petroleum fields and iron ore deposits give promise that it may some day rival Pennsylvania in industrial importance. Yet this magnificent state has little over one-ninth as many people as Philadelphia, though it is more than twice the size of the Keystone State. But the country is yet new. It is scarcely two generations since Buffalo Bill was killing on the western plains an average of 69 buffalos a day to feed the workers of the Kansas Pacific railroad. And although the atmosphere of the Wild West has now almost completely disappeared, Wyoming is far from the full development of its wonderful possibilities.

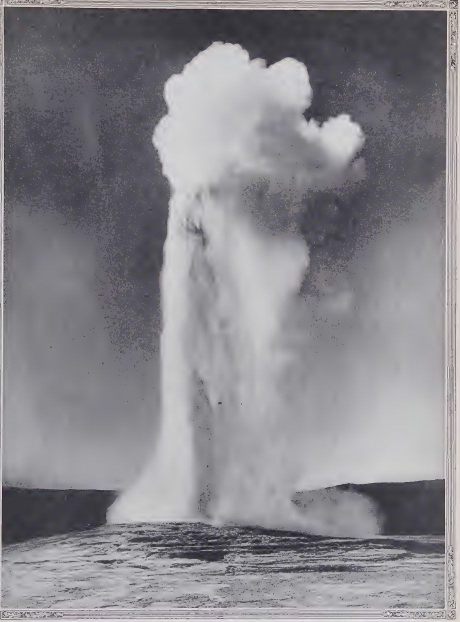
It is well known that Wyoming possesses some of the most weirdly beautiful landscapes to be seen anywhere. It contains deep and curiously carved canyons, awe-inspiring cataracts, magnificent cascades, and fantastic monuments. It has petrified trunks of trees still standing, and fossil remains have been dug up of gigantic monsters that in prehistoric times roamed its wilds. There are lakes of soda, enough to raise all the biscuits of the world; poisonous and medicinal hot springs and other mineral waters, enormous extinct geysers, chalk mountains, and painted rocks. In the southwest are examples of the famous "bad land" topography found in South Dakota. Most famous of all are the wonders of Yellowstone National Park (*see* Yellowstone National Park), a district of more than 3,000 square miles in the northwest corner of the state set aside by the national government as "a public pleasure ground and game preserve," which is visited annually by thousands of tourists.

Wyoming has a perfect regularity of outline owing to the fact that its boundaries are entirely meridians and parallels—41° and 45° north latitude and 104°3′ and 111°3′ west longitude. Only one other state—Colorado—has this completely rectangular outline. A cross section of its area, however, would present a very different picture. Lying within the widest part of the Rocky Mountain range—which crosses the state obliquely from northwest to southeast—Wyoming has the highest average elevation of any state in the Union. From its vast plains detached mountain spurs rise in lofty grandeur, with peaks surpassed in height by few in North America. Here is the continental divide, whence rivers flow north, east, south, and west to the Missouri-Mississippi, the Columbia, and the Colorado river systems. Not all of the state is mountainous, however. The east lies in the great western plain, and between the mountain ranges are wide and often fertile valleys.

In the Days of the Buffalo

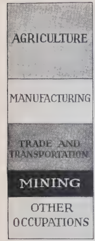
Years ago, when the only inhabitants of Wyoming were redmen, great numbers of buffalo roamed over its luxuriant grassy plains. The first white settlers brought cattle with them, which thrived without care or attention on the nutritious grasses; and for a long time live-stock raising was the only industry in the state. Farms are gradually encroaching upon the

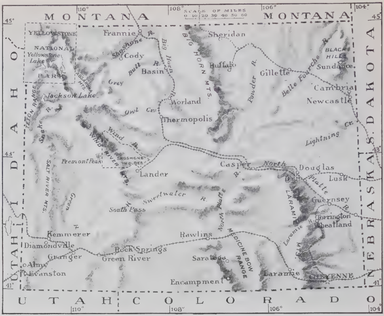
THE GLORY OF "OLD FAITHFUL"



Among its many scenic attractions, Wyoming boasts the greater part of the marvelous region known as Yellowstone Park, the home of hot springs, of strange and beautiful rock formations, and of geysers such as this. "Old Faithful" gets its name from the fact that every sixty-five minutes, without fail, it shoots up a column of boiling water and vapor, such as you see, to a height of 125 feet. The lip of rock about the column has been built by minerals contained in the water.

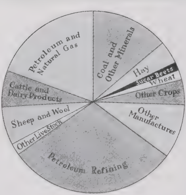
THE SURFACE OF WYOMING, ITS PRODUCTS AND OCCUPATIONS




MONTANA
MONTANA
IDAHO
SOUTH DAKOTA
NEBRASKA
UTAH
COLORADO
SCALE OF MILES
0 10 20 30 40 50 60
45°
43°
41°
110°
108°
106°
104°
YELLOWSTONE NATIONAL PARK
Yellowstone Lake
Frannie
Shoshone R.
Cody
Big Horn R.
BIG HORN MTS.
Sheridan
Buffalo
Powder R.
Gillette
Belle Fourche R.
BLACK HILLS
Sundance
Cambria
Newcastle
Bull
Basin
Grey
ABSAROKA MTS.
Jackson Lake
TETON RANGE
Snake R.
Worland
Owl Cr.
Thermopolis
Lightning Cr.
Wind R.
WIND RIVER MTS.
Fremont Peak
SHOSHONE IND. RES.
Lander
Casper
North Platte R.
Douglas
Lusk
SALT RIVER MTS.
Green R.
Sweetwater R.
South Pass
LARAMIE MTS.
Guernsey
Torrington
Wheatland
Laramie R.
Kemmerer
Rawlins
MEDICINE BOW RANGE
Diamondville
Granger
Rock Springs
Green River
Saratoga
Alma
Evanston
Encampment
Laramie
CHEYENNE

Broken ranges of mountains divide the surface of the state, with rolling prairies between. Above we see the relative number of persons in various occupations and below is shown the relative value of the state's products.

range, but about half of the state is still a great grazing ground, from which beef is sent to tables in all parts of the civilized world, and wool to the factories. The rapidity of this change is shown by the fact that from 1910 to 1920 the number of sheep in Wyoming decreased nearly 70 per cent.



Only recently has agriculture surpassed stock raising in value. The soil of the valleys of the streams and among the bases of many mountain ranges is fertile, and wherever the lands can be irrigated and the altitude is not too high abundant crops can be raised. The greatest irrigation development is in the Big Horn district in the north-central part of the state, where the United States Reclamation Service has built one of the highest dams in the world across the Shoshone River, making a reservoir that will store 148,500,000,000 gallons of water. Alfalfa and hay form the chief crop, followed by wheat, oats, and potatoes. Sugar-beet production is rapidly becoming important, owing to the beautiful and continuous days of sunshine which mature the crop in perfection and give large sugar content. There are now several sugar factories in the state. All root vegetables and some hardy fruits are raised successfully. Considerable land is still available for homesteading.

The relatively small amounts of gold, silver, and copper produced by the early prospectors led for a time to a belief that Wyoming was poor in mineral wealth. Then it was discovered that it is one of the richest coal and oil states in the union, with 30,000 square miles of coal lands, and petroleum deposits that have in some years ranked the state fourth in production. Iron and phosphate rock are also mined, and there are many other minerals ready for development when more railroads are built. There are several railroads running east and west, but no lines crossing the state north and south.

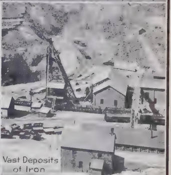
One of the chief cattle centers of the West is Cheyenne, the capital and second largest city of Wyoming, whose exhibitions reproducing the early life of Indians and cowboys on the plains draw thousands of visitors every year. Cheyenne is in the southeast corner of the state, about 100 miles north of Denver, in the midst of a rich grazing and agricultural as well as mineral country. Its manufactures are chiefly those connected with railroad and machine shops.

PROFITING FROM NATURE'S FAVORS IN WYOMING

Ranks High in Sheep and Wool

Soft Coal in Abundance

Increasing Oil Production


Vast Deposits of Iron

The Capitol, Cheyenne

Liberal Arts Building and Women's Hall, University of Wyoming, Laramie

Enormous Field Crops Led by Hay

Wyoming's early development was as a cattle grazing state. Later large areas were taken over for sheep grazing—an innovation which the cattlemen resisted bitterly at first, because sheep graze so closely that cattle cannot live on the same range. The last few years, however, have seen a great change. Farming and the exploitation of the state's vast mineral resources, notably petroleum, have become the leading industries, and sheep and cattle raising have dwindled. The dignified Capitol and the fine buildings of the State University typify the public spirit of the state.

Located on a plateau more than 6,000 feet above the sea, the city enjoys a healthful climate.

Smaller than Cheyenne is Sheridan, near the center of the north boundary of the state, which lies in the midst of valuable irrigated lands. Like Cheyenne it is important as a live stock center, and has deposits of coal in the vicinity. Laramie, 57 miles northwest of Cheyenne, is a popular summer resort, being situated on the plains close to the mountains. In addition to being the shipping and trade center for a large stock-raising and mining section, it has many factories, including rolling mills, plaster mills, planing mills, and railroad and machine shops, a large oil refinery, and the state university. Casper, situated in the central part of the state, is the first town in point of population. It is a stock-raising center, but the rapid growth of the last few years has been caused by the erection and operation of huge oil refineries employing large numbers of men.

Brilliant and continuous sunshine makes the climate of Wyoming healthful and pleasant, and the dry air causes the extremes of temperature—100° above to 36° below zero—to be felt less keenly. With an average precipitation of only 14 inches, the state is one of the most arid in the Union.

Wyoming came to the United States as part of the Louisiana Purchase. Only a few explorers had crossed its present boundaries before the 19th century, but from the days when Fremont's expedition explored the Wind River Mountains and the South Pass, in 1842, the favorite route to the Pacific led through southern Wyoming. Of all the thousands who passed on this famous "Oregon Trail," however, few or none settled permanently, because of the aridity of the land and the hostility of the Sioux and other Indians. A Mormon settlement was made on the Green River in 1853, but was abandoned in favor of Salt Lake City in 1857. Gold was discovered on the Sweetwater River in 1867, and a large inrush of population followed, leading to the founding of South Pass City. In the same year Cheyenne was laid out by the Union Pacific Railroad Company, Laramie followed in 1868, and both towns were populated almost immediately.

In 1868, Congress established a territory within the present boundaries, taking the land east of the Rocky Mountains from Dakota and that west from Utah and Idaho. The first legislature met in 1869, and granted full suffrage to men and women. The history of the territory was marked by many Indian wars, in one of which Gen. George A. Custer and 208 men of the United States army were surrounded and killed on the Little Big Horn in 1876. These wars lasted until the Indians, led by Sitting Bull and Rain-in-the-Face, were finally subdued and confined to reservations. In 1890, Wyoming was admitted as a state.

X

XAVIER (*zăv′ĭ-ẽr*), SAINT FRANCIS (1506–1552). In the long and glorious annals of Christian missions there is no more inspiring page than that which tells of the devoted labors of Saint Francis Xavier, the "Apostle to the Indies." The hardships he underwent in 11 years of incessant travel through India, the East Indies, and Japan, and the results he achieved in carrying the Gospel to remote regions where the name of Christ had never before been heard, give ample warrant for the view that he should be regarded as the greatest of Christian missionaries since the first century A.D. It is said that his travels in heathen lands covered 50,000 miles and that he baptized more than half a million persons.

A gifted youth, the youngest son of a noble family of Spanish Navarre, he began his studies in 1524 at the University of Paris, where after a few years he became a lecturer. Love of learning and love of pleasure occupied his thoughts until he met Ignatius Loyola, the founder of the Jesuit order, who often quoted to him the words, "What shall it profit a man if he gain the whole world and lose his own soul?" Loyola's solemn pleadings sank into Francis' heart and led to his determination to devote his life to holy things. He was one of the little group of earnest spirits who, under Loyola's leadership, founded the Society of Jesus in 1534. (*See* Loyola, Ignatius de.)

Francis Xavier was ordained a priest in 1537; he studied medicine, tended the sick in hospitals, and preached wherever men would listen to him. In 1541 he began the missionary career in which he spent the remaining years of his life, being sent with the rank of papal nuncio to preach the Gospel in India. On the way he lived among the common sailors, ministering to their spiritual needs and caring for them during an attack of scurvy. Landing at Goa, on the west coast of India, he labored there for several months, then began a series of remarkable journeys which covered the whole of India, the scattered islands along the coast, Malacca, and the Moluccas or Spice Islands far to the east. Finally he went to Japan, where he remained more than two years, penetrating into all parts of the country, winning many converts to the faith. His next plans were for the conversion of China, but he fell ill of fever on the way and died on the island of Sancian, near Canton, at the age of 46. He was canonized in 1621 by Pope Gregory XV as Saint Francis Xavier, and December 3 was fixed as his feast day.

XENOPHON (*zĕn′ō-fŏn*) (about 430–355 B.C.). To the boy or girl who studies Greek, Xenophon always means first of all the author of the 'Anabasis', in whose pages we read of the "upward march" (Greek, *anabasis*) and long and trying retreat of the famous Ten Thousand Greeks who entered the service of the unfortunate Cyrus the Younger, against the king of Persia. To us also comes a thrill as we read the cry, *Thalassa! Thalassa!*—"The sea! The sea!" with which the worn and wearied band, heroic in defeat, greeted at last the saving waters which should carry them home again.

This expedition, of which Xenophon was a member and the historian, set out in 401 B.C. He was an Athenian, and had been a pupil of Socrates, whose life he is said to have saved in the battle of Delium. When he returned to Athens in 399, he found his old teacher condemned to death, and wrote the '*Memorabilia*' (Recollections of Socrates) to clear the memory of the great philosopher of the charges on which he was executed.

For a time Xenophon even served Sparta in war against Athens, so great was his wrath at his native city. For 20 years he lived on an estate in Elis, given him by the Spartans, there busying himself with agriculture and literary work.

Besides the 'Anabasis' and 'Memorabilia', Xenophon's chief works are the 'Hellenica', a history of Greece from 411 to 362 B. C., and the 'Cyropedia', a political and philosophical romance in which he describes the education of Cyrus the Great, king of Persia.

XIMENES (*zĭ-mē′nēz*) **DE CISNEROS**, CARDINAL (1436–1517). At the very time when Isabella of Castile was aiding Columbus to set out upon his memorable voyage, she was also raising from obscurity a monk who wore the humble habit of the Gray or Franciscan friars. For many years this tall gaunt friar had been leading a life of severe asceticism in an obscure monastery, and the fame of his penitential life and great holiness had traveled wide. In 1492 Queen Isabella called him to her court and appointed him Royal Confessor; and although he was then 56 years old, he rose rapidly to a pinnacle of greatness to which few can aspire.

Educated at the university of Salamanca, Francisco Ximenes, or Jiménez (*hē-mä′nāth*, as the Spaniards write and pronounce it), spent several years of his early life at Rome, and then returned to Spain to receive an appointment given him by the pope. But the archbishop of Toledo refused to recognize the pope's grant, and became so incensed at Ximenes' insistence that he cast him into prison, where he remained for six years. Released from prison, he gained an important position in the Church, but soon renounced it to enter the order of Franciscans.

Upon the death of the Cardinal-Archbishop Mendoza of Toledo (not his former enemy) in 1495, the queen secured from the pope the appointment of Ximenes to this post, the richest and most powerful in the whole Spanish church. Ximenes at first refused the position, for he did not desire earthly honors, but finally accepted it after receiving express orders from the pope. Twelve years later he was also made cardinal. As archbishop of Toledo he applied himself seriously to reforms among the clergy and religious orders; and although maintaining the outward forms of splendor which his position demanded, continued to lead the simple life of a Franciscan friar.

Shortly after his accession he began to devote himself to the chief aim of his existence, the conversion of the Moors. His stern methods were attended with considerable success, and in 1505 he extended his efforts to Africa, himself leading a brilliant expedition which in one day took the city of Oran. Since the death of Isabella, in 1504, Ximenes had played a considerable part in the government of Castile; and on the death of her husband Ferdinand of Aragon, in 1516, he became regent of all Spain for the young king Charles (*see* Charles V). In the two years during which Ximenes held this position he showed himself a bold and determined statesman. He established a standing army by drilling the citizens of the principal towns, increased the maritime power of Spain, and yet paid off the national debt.

Ximenes will probably be best remembered, however, for his founding of the great University of Alcala in 1508; and for his famous "Complutensian Polyglot" Bible, which was printed there at his expense, on the plan of exhibiting in one view the scriptures in their various ancient languages. This contained the first printed text of the original Greek of the New Testament, although it happened that the Greek edition annotated by the Dutch scholar Erasmus was the first published (*see* Bible).

RAYS *that* SHOOT *Through* SOLID MATTER

The Mysterious Streams of Electrons by Whose Power We Can See into the Human Body—Their Discovery by Professor Roentgen, and How They are Used in Medicine and Other Fields

X-RAYS. In the early 90's of the last century some leading men of science thought that all the really important discoveries in physics had been made; all that remained to do was to check up facts and perfect and record measurements. The discoveries that followed in the next few years tumbled over everything that they thought they knew about the constitution of matter and the nature of electricity, and sent the wise men to find new theories or to revive old discarded theories. If this scientific earthquake had been planned as a practical joke, it couldn't have been more successful. And the innocent little vacuum tube—the Crookes tube, otherwise known as the Plücker, Hittorf, or Geissler discharge tube—was the center of the whole disturbance.

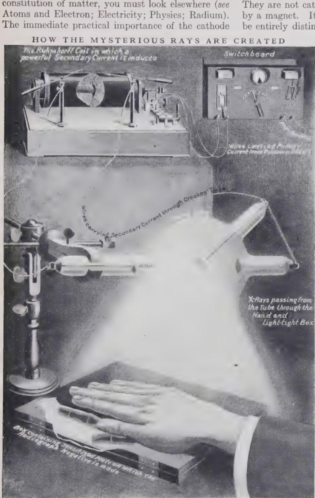
What is this wonderful Crookes tube? Just a glass tube from which the air has been exhausted and into which, at the two ends or at least some distance apart, two metal electrodes or plates are placed, held by wire connections fused through the glass. If the air is exhausted gradually while an electric current is passed through, certain beautiful luminous phenomena, arranged in definite order with reference to certain definite dark spaces or bands, appear in the tube in regular sequence as the exhaustion proceeds. Just before exhaustion of the air reaches a point at which the tube resists completely the passage of the electric current, the glow within becomes extinguished as the dark space enlarges and the walls of the tube begin to shine with a golden green light or phosphorescence, producing a weirdly beautiful effect.

What is happening in that dark cell walled with light? Something is traveling like rays from the cathode or negative plate to the opposite end of the tube, for a piece of mica coated with phosphorescent powder, placed edgewise in the path of the supposed rays, will glow brightly, and a suitable screen placed before the cathode will cast a shadow on the bright wall of the tube. So far, this seems much like rays of light. At any rate, we can call this unknown something rays—cathode rays.

One early investigator (Plücker) found that cathode rays, unlike light rays but like the electric current, could be bent out of their straight path by a magnet. Others (Hertz and Lenard) discovered that the new rays, again unlike light, could pass through gold or aluminum foil. At length Sir William Crookes, whose genius we have commemorated by calling the high vacuum tube after him, suggested that the cathode rays consisted of something whose discovery Faraday had long ago foreshadowed—matter in a fourth state, neither solid, liquid nor gaseous, but radiant matter, according to Crookes. Later Sir J. J. Thomson and others showed that Crookes' "radiant matter" consisted of streams of fine particles, and that these particles were the "atoms" of electricity, or as we now call them, "electrons." They are bodies minute beyond the power of imagination to picture, but their mass and charge have been measured with high accuracy. One writer tells us that an electron compared to an atom is like a single stone in the wall of a great cathedral.

For what is known and conjectured regarding electrons, as well as for the tremendous effect of the electron theory on the theory of electricity and of the constitution of matter, you must look elsewhere (*see* Atoms and Electron; Electricity; Physics; Radium). The immediate practical importance of the cathode rays arises out of the next discovery made in regard to them. Prof. Wilhelm Roentgen, a German physicist, found in 1895 that when cathode rays strike any substance the impact gives rise to rays of an even more mysterious nature, called on that account X-rays (or, after the discoverer, Roentgen rays). They are invisible; they produce no light, yet they affect a sensitized photographic plate and a phosphorescent screen. Many substances which are entirely opaque to light are more or less transparent to X-rays. They are not cathode rays, for they are not affected by a magnet. It was long supposed that they must be entirely distinct in their nature from light, because apparently they could not be reflected, refracted or polarized. In 1912, however, Laue, in searching for something fine enough to diffract the rays, hit upon the idea of using crystals, and the desired phenomena were produced by several workers. The rays were found to have wave lengths 10,000 times shorter than the waves of visible light. As developed by Bragg and others, this method is of immense value in studying atoms, and the structure of crystals.

HOW THE MYSTERIOUS RAYS ARE CREATED


The Ruhmkorff Coil in which a powerful Secondary Current is induced
Switchboard
Wires carrying Secondary Current through Crookes' Tube
X-Rays passing from the Tube through the Hand and Light-tight Box
Box containing Sensitized Plate on which the Radiograph Negative is made

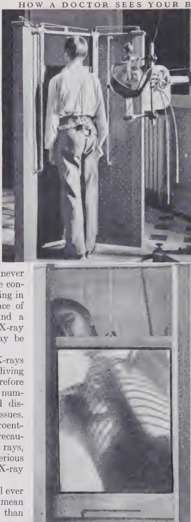
The electric current enters the Crookes tube through the "anode," the disk at the right. It crosses the tube striking the "cathode," setting up rays there. These rays are shot back at the "target," that disk which is set at an angle in the center. This sends X-rays downward through the patient's hand and into the box containing the photographic plate. The shadows of the bones are thus cast upon the plate, producing the picture.

The fascinating and also useful property of the X-rays is their power to show us things which we could never discern by other means. They penetrate certain substances, including flesh, readily; bone, less easily; and denser substances like lead and platinum little or not at all. Thus X-ray pictures reveal many secrets of the body and render invaluable services to medicine and surgery.

Formerly surgeons were at a great disadvantage in operating for conditions that lay concealed far below the surface of the body, particularly in vital regions. Now, before any up-to-date surgeon sets a broken bone, he has an X-ray taken which shows him the exact condition of the fracture and the position of the fragments. Then, after he has reduced the fracture, he has another radiograph taken, which shows just how well he has succeeded. Or, if it is a question of a bullet wound or other foreign-body injury, X-ray pictures show whether the foreign body is still in the tissues, and, if so, where it is. These are the mere commonplaces of roentgenology; improvements and refinements of technique are making it more and more possible to study tumors and soft tissues of the body in the same way.

Internal medicine, scarcely less than surgery, owes the X-ray an immense debt. The tremendously important and difficult task of the early diagnosis of tuberculosis has been made much easier by the discovery that the X-rays clearly show cavities and diseased areas at a stage preceding cavity formation. If a physician needs to know certain facts about the patient's digestion he gives the patient a meal of food mixed with bismuth subnitrate, a harmless substance which is opaque to the X-ray. Then by means of roentgenograms taken at regular intervals he can learn whether the passage of the food is unduly delayed at any point, and whether there is any abnormal kink or malposition of part of the alimentary canal.

HOW A DOCTOR SEES YOUR BONES



The X-rays proceed from the glass globe at the top, and pass easily through the fleshy parts of the patient's body, but less easily through the bones. The doctor, on the other side of the cabinet, sees the ribs and backbone as dark shadows, as shown in the lower photograph. Such a device for direct examination without the aid of a photographic plate is called a "fluoroscope."

Perhaps the physician needs to study not merely the outline of the organs but their very movements. Then he uses the X-ray and the fluorescent screen, on which he sees the shadows of the beating heart, the breathing lungs, and the peristaltic intestinal contractions.

The modern dentist will never trust to guesswork as to the condition, for instance, of a filling in a root canal, or the presence of infection or abscess around a tooth; he insists on an X-ray photograph so that he may be sure of the condition.

Continued exposure to X-rays is very destructive to living tissues. The rays are therefore used in the treatment of a number of morbid growths and diseased conditions of the tissues. For the same reason, before roentgenologists learned the precautions necessary in using the rays, there were a number of serious accidents, even death from X-ray burns.

Probably no use that will ever be found for the X-rays will mean more to human welfare than their use in medicine and surgery. Still their field is constantly expanding. Thus they have been used to discover contrabrand material in cotton bales, to detect hidden flaws in iron castings, to study the structure of crystals, and to aid in chemical analysis. It has been found for ordinary light that every substance emits its peculiar and characteristic wave-length; so we can determine a substance by the light that it gives off (*see* Spectrum and Spectroscope). It has similarly been found that every substance that gives off X-rays emits its special kinds of X-rays, that is, rays of certain definite wave-lengths peculiar to that substance. The study of the X-ray spectra of different substances, both by emission and absorption, is giving us new knowledge of the structure of atoms, for X-rays having such short wave-lengths reach the atoms.

'X Y Z' AFFAIR. In the conflict between England and France, during the French Revolution, France had confidently expected that trouble with England over the seizure of their ships would lead the United States into war. The revolutionary statesmen were bitterly angered, therefore, when in 1794 matters were arranged for the time being by a treaty. The French government, the Directory, declared that the United States had not kept its agreement with them; and they insultingly refused to receive the American minister, Charles C. Pinckney, and began to seize American ships.

When John Adams became president, in 1797, he was anxious to avoid war, and so sent three agents —Elbridge Gerry, Pinckney, and John Marshall—to France to settle the difficulty. France finally appointed three representatives to meet these men, but the three tried to frighten the American agents and demanded money for the Directors.

When the letters regarding the negotiations were laid before Congress, the names of the French agents were omitted, and the letters *X*, *Y*, and *Z* were substituted. The demand so angered the Americans that war actually existed for a time. Then France gave in and the matter was settled by treaty. It was during this affair that Pinckney is said to have told the French minister Talleyrand, "Millions for defense, but not one cent for tribute."

YAK. No large animal habitually lives at greater heights than this member of the ox family, which is found in a wild state on the high plateaus of Tibet between the Altai and Himalaya Mountains.

It is about the height of a small ox and can at once be distinguished by the long hair which hangs from each side like a curtain, in some cases touching the ground. The color of the wild animal is black, but some of the domesticated breeds are black and white; and the hair is longer in the domesticated than in the wild forms. The tail also is very hairy, and the white tips are cut off by the Chinese, who dye them red and use them as tassels. In India they are used as fly-snappers. There is a hump over the forelegs and this is exaggerated by the hairy mane.

THE TIBETAN'S FRIEND

What the reindeer is to the Laplander, the Yak is to the native of Tibet. Not only is it the sole beast of burden that can survive at such heights, but it provides also food and clothing.

The yak has been domesticated for centuries in Tibet and forms a great part of the natives' wealth. Its milk is rich and the curd is much used both fresh and dried; it makes excellent butter, which is preserved for a long time in bladders, and forms an important article of commerce. The flesh, too, is of fine quality and is often dried and eaten raw. The hair is spun into ropes and made into tent coverings, and the soft fur on hump and shoulders is woven into cloth. The skin with the hair on is used for caps, coats, and blankets. The yak is extensively used as a beast of burden, but never for tillage or draft. It feeds on grass. Scientific name, *Bos grunniens.*

YANGTZE (*yăng'tsĕ*) **RIVER.** "Ta-kiang" (or Great River) is the name which the Chinese usually give to their longest and most important waterway, which ranks among the great streams of the world. "Yangtze-kiang" (which means Yangtze River) is used by them only for the lower part, and other portions have different names. From its source in the Kuenlun Mountains of Tibet to its mouth in the East China Sea, this great river traverses the center of the country from east to west for a distance of some 3,000 miles, forming with its many connecting canals and rivers a highway of communication unparalleled in the world. Its basin of about 500,000 square miles includes the greater part of China proper.

The great cosmopolitan city of Shanghai, the commercial outlet for the whole of the basin, is situated 12 miles south of the mouth of the river. Here you may begin your trip up the river in a large ocean steamer, and will not have to change ships until you reach Hankow, an inland port that is nearly as far from Shanghai as Toledo is from New York. At its mouth the Yangtze River is 30 to 40 miles wide, and for a considerable time land is not visible. But finally you see the seaport of Chinkiang on the north bank, and after several days' journey through one of the most beautiful garden spots in the world, arrive at Hankow. The Hankow district is the commercial heart of China, and contains an amazing population (*see* Hankow). Every square yard on the shore seems to be the home of some family, and thousands of people spend their entire lives on the river in junks, houseboats, and "sampans."

Above Hankow the volume of water diminishes greatly, but by changing to a river steamer one may go 500 miles farther inland through a lake-studded country flanked with rich agricultural lands on either side. In flood times the lakes on the course of the Yangtze take much of its surplus water so that, unlike the Yellow River, it rarely causes death and destruction. Above Ichang steam navigation ceases, for here are the famous Yangtze gorges and rapids, which continue throughout most of the great bow-like trend to the south. This is by far the most beautiful part of the river, if we except its upper course in Tibet. The Chinese, by using great gangs of coolies, sometimes haul small boats 500 miles above Ichang. In its lower course the river is not so rapid, and carries in suspension a vast amount of silt, which it deposits in the Yellow Sea at an estimated rate of 6,000,000,000 cubic feet a year.

YANKEE. When the early Indians tried to pronounce the French word *Anglais*, meaning "English," the nearest they could come to it was "Yenghees." This is one explanation of the origin of the name Yankee, which was used by the English soldiers in derision of the untrained American troops who fought alongside them in the French and Indian War. Other explanations connect the term with the Scotch word Yankee, meaning "shrewd" or "excellent."

The tune to the well-known song 'Yankee Doodle' is an ancient one and was widely sung by the common people of Italy, Holland, and England as early as Shakespeare's time. In Cromwell's day the Cavaliers used it for a song in which they derided the Puritans, one verse being in this familiar form:

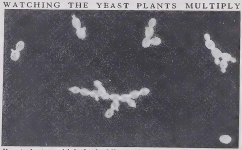
> Yankee Doodle came to town
> Upon a Kentish pony,
> He stuck a feather in his cap
> And called it "macaroni."

At that time the term "macaroni" was given to London dandies who followed ridiculous Italian styles. By the time of the Revolution the song as adapted to Americans was well known in New England and was sung and whistled to taunt the British as they retreated from Concord. It soon became a national American air.

Applied at first only to New Englanders, the term Yankee was given by the Confederates in the Civil War to all Northerners. Since that time the name has been popularly given to all Americans, to distinguish them from the people of other nations. It was in this sense that the phrase "the Yanks are coming" was used in a popular song during the participation of the United States in the World War of 1914–18.

YEAST. Your mother buys a yeast cake when she wants to make bread. It has an odd smell, and does not seem alive at all. But mother takes a half-cup of warm water, and a little flour, and a tiny bit of sugar, and mixes them. Then she breaks her yeast cake into the cup, stirs all together, and stands the cup in a warm place. If you ask her why she does this, she may say: "I want to see if that yeast is alive."

WATCHING THE YEAST PLANTS MULTIPLY



Yeast plants multiply by budding or "gemmation"—you can see some of the tiny buds forming in this highly magnified picture. As the cells bud and grow, they often form long chains, which later break up.

Now watch it! Soon little bubbles begin to burst. The batter swells and foams, and rises to the top of the cup. If you could study it with a microscope, you would see that the whole mass is in motion. Mother says the yeast "ferments," but that, in the case of yeast plants, means *growing*.

There, the secret is out. Mother has made a garden. The flour and water and sugar are soil. In the soil she scattered yeast plants, just as a farmer scatters seeds in a field. For everyday yeast is really a mass of low-grade microscopic plants, belonging to the fungus family and akin to bacteria. Each plant is a single, simple cell, which produces new cells by a peculiar budding process. Usually the cells thus produced cling together in short chains. There are about 25 species of yeast plants, of which the kinds used by bakers and brewers are best known.

The usefulness of these tiny yeast plants consists in their ability to produce fermentation in starch and sugar solutions. The chief products of this fermentation are alcohol and the gas carbon dioxide. The alcohol-making properties are employed in brewing and the manufacture of wines; but when mother is making bread she is interested only in the carbon dioxide. It is this gas which forms the bubbles in that foaming cup, and which will make the bread light by filling it with those little round holes. While science has still much to learn about the action of yeast, it is believed that the chemical changes it produces are due to a substance called *zymase* in the yeast plants (*see* Enzymes; Fermentation).

Now all that mother has to do to put these wonderful little plants to work is to mix the yeast paste with flour and water, stirring and kneading it finally into thick dough. The dough is then put away to "rise," which simply means that the yeast puffs it all up with little gas bubbles. When the bread is baked, the yeast is killed and the alcohol evaporates and you have nice light bread.

There are a great many other plants much like yeast. One of them is the blue mold which grows on old bread, and on the top of glasses of jelly. Under a microscope it is very beautiful. It is a feathery mass of delicate blue threads. Black molds and mildews, rust on wheat, black smut on corn, and mushrooms and toadstools all belong to the same group, the *Fungi*. You can read further about these interesting cousins of the yeast plant and their strange habits of life in the articles on Fungi and Mushrooms.

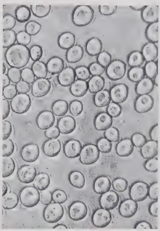
The making of yeast is now a business in itself, carried on by great factories. Some of these manufacture 100,000 pounds of yeast a day, and the cakes can be bought at any grocery or bakery. These yeast cakes are of two kinds—compressed yeast, which is soft and smooth in consistency, and a hard yeast cake, which is dry and crumbles easily.

Various processes are used in the manufacture of yeast but all are based on the same principles.

The tiny yeast cells must be provided with proper nourishment and plenty of air, under carefully controlled temperature.

The proper food for the yeast plants is corn, barley, malt, and rye. The grains are cleaned, ground in mills, and then "mashed," or mixed with filtered water. The corn must also be "cooked" before it is mixed with the other ground grains. Malt or sprouted barley is then added to the "mash," in order to convert the starch of the corn and rye into malt sugar, which is the food that yeast plants thrive on best.

YEAST CELLS MAGNIFIED



These cells are magnified 1,000 times. You can understand how small the cells really are when you learn that a single cake of yeast, such as you buy for two or three cents, contains millions of such cells.

The next step in the process is the addition of a pure culture of lactic acid bacteria. These are the bacteria which cause the souring of milk. They make the grains still more digestible for the little yeast plants, and also insure a healthy fermentation. This action takes place in the "souring tank."

The mash is now ready to be filtered, and the clear filtered extract is called the "wort." After being cooled, the wort is piped into huge copper tanks. Here living yeast plants from a former batch are added to start the growth of a pure culture, and the proper conditions for fermentation are supplied. The little yeast plants grow very rapidly, as they do later in the making of bread. At the end of about 12 hours, a great mass of yeast substance has been produced from the wort.

The yeast is next separated from the liquid, the water is pressed out of it, and it is mixed thoroughly and molded in blocks. The last step in the process of yeast manufacture is to cut the blocks of yeast into the small squares we are familiar with, and wrap them in their coverings of tinfoil or paper.

YELLOWSTONE NATIONAL PARK. "Stand back!" shouts the guide, "she's a-comin'!" The tourists run back a few steps from the colorful pool of steaming water edged with queer biscuit-like stones, and a moment later a stupendous glittering fountain of water hurls itself hissing from subterranean depths up into the sky. Soon another hidden monster awakes and another and another, sending forth scalding volcanic streams of water from their mysterious underworld. The spouts soar from 10 to 250 feet into the air, at regular intervals varying from minutes to hours, days, or weeks.

"That one there is the Giant," says the guide. "It hurls up a column of water 200 feet high every five to seven days. And over there is Old Faithful, that spouts a column 125 feet high every 65 minutes, and has never been known to miss fire."

The tourists look again and gasp as the famous geyser bursts forth into play before their eyes.

They are spending their vacations in America's great playground, the Yellowstone National Park, in the northwest corner of Wyoming and extending into Idaho and Montana. It contains 3,350 square miles, over two and a half times the size of Rhode Island.

Situated in the very heart of the Rockies, Yellowstone Park is a veritable American Switzerland. It is densely forested with black pine, balsam, fir, spruce,

A RAINBOW IN STONE—HYMEN TERRACE IN YELLOWSTONE PARK

At Mammoth Hot Springs, in the north of the Park, the lime-laden waters have built up terrace on terrace of marble-like rock, tinted with pink, red, blue, and yellow by the algae found in the water. Nowhere else in the world are such formations known to exist.

and poplar. Foaming trout streams tumble into clear mountain lakes which mirror the snow-clad peaks. Flowing from Yellowstone Lake, one of the most beautiful mountain lakes in the world, Yellowstone River plunges over a precipice twice as high as Niagara into a marvelous multi-colored canyon. Here too Nature displays her curiosities to amuse the visitors. There are more geysers in the park than in any other geyser region of the world, and it is noted also for its petrified trees, for its boiling lakes and hissing hot springs and the scalloped terraces down which their waters pour; for its bubbling caldrons of many-colored clays. In its wildernesses, protected from hunters, roam deer, bison, antelope, bear, and other wild creatures.

One of the most famous sights is the great white cone, several hundred feet high, of the Mammoth Hot Springs. This consists of terraces of beautifully scalloped basins, streaked with bright red and yellow caused by the algae that live in the water. The water issues at the summit at nearly boiling temperature and gradually cools as it flows to successive basins at lower levels.

THE COMMON ENGLISH YEW

See how heavily this Yew branch is laden with its bright scarlet fruits. The foliage of the Yew is poisonous, especially to horses and cattle, but the leaves were formerly used as a medicine for human beings.

This largest and most celebrated national park in the United States was set aside in 1872. It is an ideal summer visiting place for tourists, with many large hotels, public camps, etc., and with 200 miles of excellent roads. The park has entrances on all four sides, three of which have railroad connections. It is directly in charge of an army officer superintendent who enforces necessary regulations with the aid of soldier patrols.

YEW. In the days of Robin Hood, before gunpowder had taken the place of bows and arrows, the strong and elastic wood of the yew tree was in great demand in England for the making of bows. Probably this is one of the reasons that explains why yews are found in nearly every churchyard in England. They were planted to insure a good supply of staves for making bows, as well as to protect the churches from high winds with their sturdy growth. It also became customary to clip the yew trees into smooth compact cones or pyramids of green, or into complicated geometrical shapes, and even into the semblance of grotesque beasts and birds.

The yew is a very slow-growing tree requiring a century or more before it is large enough for cutting. It is also a very long-lived tree. Some of the oldest specimens in England are over 10 feet in diameter and estimated to be over 1,200 years old. Yew wood is highly valued for cabinet-making, being close-grained, of a reddish color, and capable of taking a smooth and beautiful polish.

Yews belong to the genus *Taxus* of the evergreen family (*Coniferae*). They are usually small trees or shrubs and are distributed throughout the Northern Hemisphere. The common yew of Europe (*Taxus baccata*) is hardy in North America as far north as Rhode Island. In England it is rarely more than 20 feet in height, while in the Himalayas it may even reach 100 feet. The tree is densely clothed with dark green foliage. It is especially beautiful in autumn when it is loaded with its bright scarlet fruits.

The American yew or ground hemlock, *Taxus canadensis*, is a low straggling wide-spreading shrub which is hardy as far north as Canada. The California or short-leaved yew is a tree from 50 to 70 feet high found on the Pacific coast. The Japanese yew, the hardiest of the family, has been introduced into the United States, and many fine specimens have been reared.

The naked seed is surrounded by a fleshy cup which gives the appearance of an open berry. The leaves are flat, $\frac{1}{2}$ to $\frac{3}{4}$ of an inch in length, yellowish green on the under side, and poisonous. The small and solitary flowers appear in early spring.

YOKOHA'MA, JAPAN. The first thing the traveler notices, as his ship sails into the wide exposed harbor of Yokohama, the principal seaport of Japan, is a long stretch of stone breakwater, within which lies a haven of perfect safety. This is a lasting monument to the friendly relations between Japan and America in the early period of their intercourse. In 1863 the feudal lord of Choshiu fired upon an American steamer passing through the straits of Shimonoseki in southwestern Japan and this hostile act resulted in Japan's paying the United States an indemnity of $800,000. A few years later the money was returned, and Japan, wishing to expend it in some way that would perpetuate in visible form the good will of America, decided to use it for the improvement of this harbor.

When Commodore Perry anchored off the coast of Japan, in 1854, Yokohama was an insignificant fishing village. In 1859 the Japanese government opened it as a treaty port and merchants of all nationalities, eager for trade, settled there in large numbers.

Thenceforward the city grew rapidly. It was connected with Tokyo, 18 miles north, by the first railroad in Japan (1872), and many fine buildings were constructed both in the town itself and in the foreign residential settlement on the "Bluff," a well-wooded hill commanding a beautiful view of the bay. These were nearly all destroyed by the great earthquake and fire of 1923, which left all but a fringe of the city in ruins and killed a hundred thousand of the inhabitants.

Yokohama handles the bulk of Japan's shipping, which has increased enormously during recent years, for in foreign trade expansion Japan ranks second only to the United States. Silk, copper, tea, fish, paper, toys, tanned leather, and manufactured goods of all sorts pass through this port of the empire, and thither foreign vessels bring sugar, cotton and cotton goods, wool and woolen goods, metal, rice, oil, and machinery.

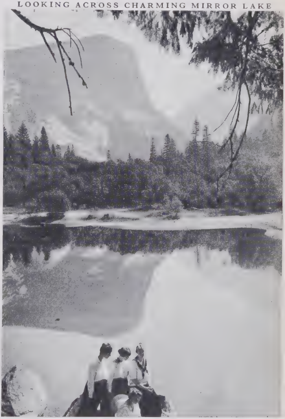
A considerable element of the population is Chinese, French, German, British, and American. With ships and merchant vessels flying the flags of every nation in her harbor, and tourists and sailors from all parts of the world along the "bund" (waterfront) in the bazaars and theaters, Yokohama easily supports its claim to being the most cosmopolitan city of Japan. Population, about 525,000.

YORKTOWN, VA. Yorktown, the county seat of York County, Va., has twice figured prominently in American history —in 1781 and in 1862. The little hamlet, situated on an arm of Chesapeake Bay, was the scene of the surrender of the British general, Lord Cornwallis, in 1781 —a surrender which virtually closed the Revolutionary War. It was again besieged in 1862 by General McClellan, the Union commander. Today the village, with a population of less than 200, contains a monument erected in 1881 to commemorate the surrender of Lord Cornwallis. It is noted also for having, on the principal street of the town, the oldest custom-house in the United States. (*See* Civil War; Revolution, American.)

YOSEMITE (*yō-sĕm'ĭ-tē*) **VALLEY.** So full of wild and varied beauty is this famous valley in central California that it has been made part of the Yosemite National Park to preserve a loveliness which travelers declare to be unequaled in all the world (*see* National Parks). It is 150 miles east from San Francisco, nearly eight miles long and a mile wide, "a mountain street full of life and light, graded and sculptured by the ancient glaciers . . . all enlivened and made glorious with rejoicing streams that come chanting in chorus over the cliffs and through side canyons in falls of every conceivable form, to join the river that flows in tranquil, shining beauty down the middle," to quote John Muir, the great naturalist and first apostle of the Yosemite.

The Yosemite Valley is a splendid example of glacial erosion on a grand scale. Five glaciers here united to carve this vast canyon out of solid granite.

LOOKING ACROSS CHARMING MIRROR LAKE



This view gives you some idea of the charm of the Yosemite valley. The peak in the background is Mt. Watkins, and the water at its foot is so still that the scene mirrored in its surface is almost as clear as the actual view above.

Near the upper end of the valley the Merced River plunges from a height of 600 feet, forming the famous Nevada Falls. The gauzy floating Bridal Veil Falls is about 900 feet high. Most magnificent of all is the Yosemite Falls, where the Yosemite Creek descends to the valley in three leaps of about 2,500 feet altogether. Besides these there are the narrow Ribbon Falls, the Tenaya, the Vernal, the Illilouette, and dozens of smaller falls and cascades. Between the poised rock walls of the canyons run meadows of plumy ferns, starred with lilies, tuneful with humming-birds and bees, the home of frail and transient beauty as the stern peaks are the throne of majesty and endurance.

Near Yosemite also is the refuge of forests of giant conifers such as the sequoias—solemn, colossal trees, perhaps the oldest living things in the world. They are to be found 10 or 20 miles from the lower end of the valley, which is itself sweet with great feathery pine groves. Not far from the Yosemite Valley is the Hetch Hetchy Valley, its only rival in loveliness, running along the Tuolumne River as the Yosemite Valley follows the course of the Merced.

YOUNG MEN'S CHRISTIAN ASSOCIATION. An American war worker in Italy was puzzled by the enthusiastic praise expressed by Italian soldiers in broken English for the "American *Imca.*" Then it dawned upon him that it was the Y.M.C.A. they were praising. On every front in the World War, and in every camp in America, the "Y" huts were centers of comfort and amusement to the soldiers. But this great war work was only a part of the vast operations—religious, physical, educational—carried on in peace as well as war—for civilians as well as soldiers—among young men and boys of every class and in every clime, by this great international organization, whose symbol is the Red Triangle, standing for the equal upbuilding of "Mind—Spirit—Body."

The Y.M.C.A. is the creation of a country boy, George Williams, who came to London and obtained work as a clerk in one of the leading dry-goods houses there. He had business ability which fitted him to attain, later in life, unusual success as a merchant in the great city; but it is for his interest in his fellow-workers that his name is remembered and honored by all. He wanted to improve the environment of young men, to give them broader opportunities, and to transform character through the Christian life. He began by inviting a little group to meet with him for prayer and Bible study. Later the idea came to him of forming a club, and his roommate suggested that he call it "the Young Men's Christian Association." So on June 6, 1844, 12 young men in London met and organized a club for the "improvement of the spiritual condition of young men in the drapery and other trades." Thus our familiar Y.M.C.A. had its beginning. Using the influence and money which he gained later in life, Mr. Williams helped to spread the association throughout England and to several countries on the continent, and he was knighted by Queen Victoria for his work in 1894; he died in 1905.

In 1851 the movement spread to America, where it has since had its greatest development, the first associations being established in Boston and Montreal. Gradually the organization became world-wide in its influence, until it now has branches in Australia, Brazil, China, Japan, India, Germany, and many other countries, and over a million members.

From the day of its beginning to the present, the association has always had the same definite purpose in the work undertaken by it—to make men cleaner and better in their personal life. But how different now the facilities at its command! Beginning with no equipment, it has today many buildings that cost a million dollars each. It offers homes to young men in its hotels, and provides reading and social rooms, gymnasiums, and employment bureaus. Members have the privilege of joining courses in commercial and other studies, in addition to Bible classes, and of attending many excellent lectures. The work of the Association has spread among all classes, including railway employees, college students, sailors and soldiers, Indians, and Negroes. Its activity has also been extended from the city to rural districts, and boys' organizations have been added to the men's. During the World War this vast organization raised many millions of dollars, with which it rendered great service to the men in the trenches.

Any young man of good moral character, regardless of his race or religion, may enjoy the privileges of the association as an associate member; but only active members may vote or hold office. The condition of active membership is affiliation with some evangelical church, in accordance with the following fundamental principle of the Association, which was adopted in an international convention held in 1855: "The Young Men's Christian Associations seek to unite those young men who, regarding Jesus Christ as their God and Saviour, according to the Holy Scriptures, desire to be His disciples, in their doctrine and in their life, and to associate their efforts for the extension of His kingdom among young men." In each country is a national organization, the headquarters for the United States being in New York. These national associations are further united in a world organization with headquarters at Geneva, Switzerland.

YOUNGSTOWN, Ohio. As the heart of the second largest steel district in the United States, the prosperity of Youngstown is built on an enduring basis. The Mahoning River, which divides the city into north and south sides, is lined for 21 miles with steel works, blast furnaces, and rolling mills. The Youngstown steel district, which extends into Pennsylvania and includes works in the Mahoning, Shenango, and Beaver valleys, produces one-sixth of all pig iron and one-eighth of all steel made in the United States.

Native iron and limestone gave the industry its start in 1805, when a blast furnace was built in Youngstown. Ohio coal supplies enabled the city to continue producing iron when charcoal ceased to be used (the second blast furnace in the United States to use uncoked bituminous coal was built here in 1846); and advantages of situation and transportation enable Youngstown to continue to compete with Pittsburgh now that Lake Superior ore and Pennsylvania coal must take the place of failing native supplies. The carriage of raw and finished products of the steel works produces what is said to be the heaviest traffic point in the United States a mile east of the city. Several of the works operate by-product coke-oven plants, which produce large quantities of tar, benzol, toluol, naphthas, and other by-products.

The steel industry has attracted many subsidiary manufactures—steel furniture, steel sash, blast furnace equipment, engines, boilers, tanks, bridges, cars, cranes, etc. The neighboring limestone quarries not only contribute to the steel industry but supply material for one of the largest paving-brick plants in the world, for fertilizer, and other by-products. Other manufactures include automobile trucks, gas mantles, electric light bulbs, wagons, rubber, cement, etc.

The city contains many beautiful features, despite its industrial character. Mill Creek Park, 485 acres in extent, is one of the largest and most beautiful parks in the state. The Butler Art Institute is notable for the beauty of the architectural design, and the mural paintings of the Mahoning County Courthouse, by E. H. Blashfield and C. Y. Turner, are famous. Population, about 140,000.

YOUNG WOMEN'S CHRISTIAN ASSOCIATION. Do you know the Blue Triangle? It is the good-time sign for girls. Thousands of girls in America love it and the girls of many foreign lands are learning to love it also. In every large city the "Y.W.C.A." hangs out the Blue Triangle, and every lonesome girl knows, when she sees it, that there she can get "what she needs most, next."

Jenny Jones has left the country village for her first city "job." Rather homesick, somewhat confused, very dusty, and entirely strange, she leaves the train in the railway station of the big city. The Travelers' Aid secretary seems to be waiting just for her. She sends Jenny Jones to the Y.W.C.A. building. There she is greeted by a smiling-faced young woman who answers her questions, directs her to the dressing and rest rooms where she may freshen up a bit, tells her where to find the cafeteria, and even helps her to find a lodging place. She is often invited back to the Association rooms, where the welcome is so cordial that she soon loses the sense of strangeness and begins to feel that she has become a part of it all. It is in just this way that hundreds of Jenny Joneses, each year, as they enter their new world of business, find their first and best friends in the Y.W.C.A.

But taking care of strangers is the smallest part of what the Blue Triangle stands for. Thousands of girls have had to stop school to earn their living. To these girls the Y.W.C.A. says, "Never mind if you couldn't go to school long enough to learn to do the thing you wanted to. Come, join our night classes and you shall have the best of teachers to help you." Perhaps a girl likes sewing—there are classes in dressmaking and in millinery. Perhaps she likes office work—there are business classes. Perhaps she wears a new diamond ring, and wants to learn to cook, just for two—there are the "diamond ring" cooking classes. And, in case a girl isn't sure just what she does want, there are vocational guidance experts to help her decide this important question.

The Blue Triangle also knows that when a girl sits still all day, or stands behind a counter, or bends over a machine, she needs a chance to move about at night and use other muscles, so the Y.W.C.A. has large airy gymnasiums. There are games and dances; there is a swimming pool with a teacher; there are dramatic and literary clubs; there are glee clubs and choruses; there are good-time parties and "get-togethers," so that all the members of each big family may know one another; and there are Bible classes and vesper services, for, through and above all, the "C" part of the Y.W.C.A. is emphasized.

With the summer days come the hikes and picnics, tennis and boating, and, best of all the summer camps, far from the sound of trolley and elevated train. Here the Blue Triangle stands for middy-blouse and bloomers, tanned faces, red blood, and lungs full of oxygen, a "sample package of Heaven," as one girl called her two weeks out of doors!

In seaport towns, the immigrant girl soon learns to know the Y.W.C.A. And because she speaks a strange language and has to learn American ways, the Association has a special home for her, and special secretaries who understand and speak her language. In all American cities where the foreign girls land, the Blue Triangle hangs above the door of the International Institute. Here the strangers are made welcome. Here they are taught to speak the language of their new sisters, to know and to love their new homeland, to revere their new flag, and with all this to cherish whatever of good they have inherited from the older lands of their fathers.

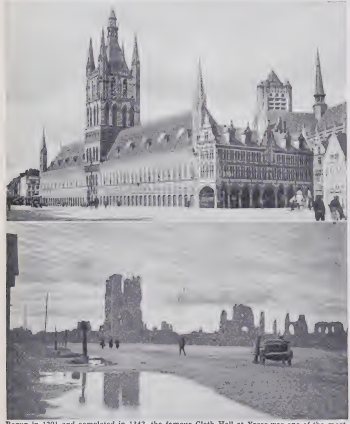
During the World War, the associations of the United States and other countries did an immense amount of patriotic service. The American association established "Hostess Houses" at all the training camps and important military centers both at home and abroad, and maintained "Service Centers" for women who took the place of men in industry.

The Y.W.C.A. movement in England dates from 1855, when Miss Emma Roberts formed the English Prayer Union, and in the United States from 1858, when the Ladies' Christian Organization of New York City was organized. The Young Women's Christian Association of Boston was established in 1866, with many of the educational, religious, and social features of the present movement. Similar organizations soon sprang up, and a National Association was formed in 1886. In other countries too progress was rapid, until there are now national organizations in the leading countries of the world, with a total membership of about a million.

YPRES (*ē'pr'*), BELGIUM. No name connected with the World War, perhaps, will live longer in men's minds than that of Ypres—the "Wipers" of the British Tommies—a famous old city in West Flanders, 35 miles south of Ostend.

In the 13th century Ypres was one of the most important cities in western Europe and the center of the manufacture of woolen cloth. With the decline of that industry and the passing of time, it became a quiet little town of 17,000 inhabitants, whose chief occupation was the leisurely manufacture of hand-made lace. There remained, however, the beautiful Cloth Hall, one of the finest specimens of Gothic municipal architecture in Europe; the old Gothic Butcher's Hall, with its museum of antiquities and paintings; the wonderful medieval cathedral of St. Martin; and many other works of art, the pride of the burghers and a testimonial of the city's former glory. Then came the World War of 1914–18, and swept away with its ruthless destruction all these famous edifices, leaving at its close a city of wooden huts in the ruins of Ypres, and a huge graveyard in the country about.

A SACRIFICE TO THE GRIM GOD OF WAR



Begun in 1201 and completed in 1342, the famous Cloth Hall at Ypres was one of the most beautiful early Gothic buildings in all Europe. The upper photograph shows it before the World War; the lower one, after the war, when countless German shells and a catastrophic fire had left only a part of the tower and here and there a few feet of wall.

Ypres was never held by the Germans, but it was bombarded continuously by them throughout the war. The battle of Flanders began with an attack on the city, in October 1914, and just south of it was fought the furious battle of St. Eloi, in March 1915. The salient then formed was not straightened out by the Allies until the summer of 1917. Again in the spring and summer of 1918 Ypres was threatened in the German offensives. It came to be called the "City of the Dead," but it is now restored to much of its former beauty, and has about the same population as before the war. But its glorious treasures of architecture and painting are gone forever, a loss to all mankind.

YUCATAN (*yụ-kȧ-tăn′*). This tropical peninsula, which shuts off the Gulf of Mexico from the Caribbean Sea, is about the size of the state of Minnesota, about 400 miles in length by about 200 miles in breadth. It comprises the Mexican states of Yucatan and Campeche; some parts of British Honduras and of the republic of Guatemala lie within it. The eastern coast is indented with numerous bays, some forming excellent harbors. The face of the country is low and level, except in the east where a chain of hills extends from northeast to southwest. The climate is hot and dry, for the absence of high mountain ranges to intercept the moisture-bearing clouds from the Atlantic gives it a limited rainfall. The soil in some portions is very fertile, yielding abundant crops of corn, cotton, tobacco, sugar-cane, and especially the sisal hemp from which harvester twine is made. The inhabitants are mostly Indians and half-breeds. The capital of the Mexican state of Yucatan is Merida, with a population of 63,000.

For centuries a glamor of romance has surrounded the Mayas of Yucatan, a people who attained a wealth and splendor of civilization far beyond that of any other early people of America, then abandoned their cities to the forests which soon enveloped them. The Mayas were dwelling among the remnants of their former glory when the first Spanish conquistadores entered the peninsula in the 16th century.

According to their records they were flourishing 2,000 years ago; by 300 A.D. they were living in beautiful cities in Central America. They devised a calendar and a chronological system that can be harmonized with the European system, and art flourished. A few centuries later they migrated to northern Yucatan where there was a renaissance of their brilliant culture.

The typical Mayan construction is faced concrete, the limestone in the region yielding abundant material for both mortar and stone. Two- or three-story houses were common and ruins of five-story "skyscrapers" have been found. These buildings were ornamented with intricate carvings which reveal a keen artistic sense as well as skilled workmanship. Although metals suitable for tools were rare, gold and copper were used in the fashioning of ornaments. The Mayas were expert potters and have left many exquisite products of their skill. They had books on history, religious rites, and magic which were written in hieroglyphics. From three of these books, which still exist, scholars have learned much of the Mayan calendar and religion.

YUCCA. Few plants native to the warmer portions of North and Central America find a wider variety of uses than the yucca, a plant of the lily family. One strikingly beautiful species adorns many gardens in the southern part of the United States; other species supply coarse tough fibers with which the natives of Mexico and Central America make heavy ropes. The fruit of one yucca resembles a small banana and is eaten in Mexico and Central America. The roots contain a substance which is used as a substitute for soap.

The common bear-grass (*Yucca filamentosa*) of the Southern states forms near the surface of the ground a rosette of soft weak leaves fringed with fraying fiber, from which shoots up a splendid spike of creamy, drooping bellshaped blossoms. The "Spanish bayonet" (*Yucca gloriosa*), another species of the Southern states, has a single woody stalk, which grows as tall as a man or taller, and which bristles in its upper portion with terrible stiff dagger-like leaves; no creature of flesh and blood could ever attempt the passage of a thicket of Spanish bayonets. Still other species found in Mexico and the southwestern United States are treelike in height and form.

The manner in which the yucca is fertilized is one of the wonders of plant life. The anthers of the large white blossoms reach nowhere near the stigma, and the plant depends for its survival on certain little white moths. During the day the yucca moths, either singly or in pairs, rest with folded wings within the half-closed flowers. After dark, however, the female sets to work scraping pollen from the anthers, and when she has secured enough for her needs, shapes it into a pellet two or three times the size of her head. Flitting to another flower, she lays an egg in the soft tissue of its pistil. Then she runs quickly to the top of the pistil and thrusts the pollen ball into the stigmatic funnel, ramming it down with her head. She thus pollinates the plant, so that seeds may be formed to furnish food for the larva when it hatches.

There are about 30 species of the yucca, which is a genus of the family *Liliaceae*. Its flowers are numerous, usually white, bell-shaped, and pendulous. From the flower there develops a succulent berry in some of the species and a dry three-valved capsule in others.

YUKON *(yu'kŏn)* **RIVER.** Owing to the slight development of railroads in Alaska and Yukon Territory and the growing importance of that region, the mighty Yukon River, which with its tributaries furnishes in summer 3,500 miles of navigable waters, has a value which can scarcely be overestimated. With the exception of three and one-half miles of rapids, the river is open to steamboat navigation during the summer months from Lake Bennett, 15 miles north of its source, to Bering Sea, where it discharges its waters, a distance of more than 2,200 miles. Without this navigable waterway, the development of the great gold fields would have been much slower and more difficult. Perhaps no other river in the world has so great a stretch of navigable waters in proportion to its length. Small steamboats have even descended the entire series of rapids, but on the up-journey the largest of these, the White Horse, presents an insurmountable barrier, and a railway now connects the two navigable parts of the river at this point.

The Yukon is unique among rivers in that it rises within 15 miles of an arm of the Pacific Ocean and flows in a great arc until it finally reaches the same ocean again on the west coast of Alaska. It finds its source in numerous small streams of the Chilkoot Pass Mountain in British Columbia, but has for its main forming basin Lake Bennett, 2,160 feet above sea-level, on the southern boundary of Yukon Territory. It flows first north and northwest, and after entering Alaska turns abruptly and flows southwest for the remaining 1,500 miles of its course. In most of its upper course it is a shallow narrow stream, expanding at intervals into several lakes. Ninety-five miles north of Lake Bennett it dashes through a gorge in a series of rapids where the fall is 35 feet.

About 175 miles below the rapids, the Yukon is joined by the Pelly River; and above this point it is called the Lewes River by some geographers who consider that the junction of the latter stream with the Pelly forms the source of the Yukon proper. Among other large tributaries are the White, Stewart, Klondike, and Forty-Mile Creek rivers in Canada; and the Porcupine, Tanana, and Koyukuk rivers in Alaska. The scenery on the Yukon is strange and beautiful at first sight, but eventually becomes somewhat monotonous. Most of the country is mountainous, with dense forests of spruce, birch, and poplar. In Alaska its course lies through the region of the great Yukon Flats, on the Arctic Circle.

At the junction of the Yukon with the Klondike River lies Dawson, the capital of Yukon Territory and the port for the golden Klondike, where over a hundred millions in treasure have been mined. This is the largest settlement on the river, the rest being small supply and trading stations, most of them within the Alaskan borders.

YUKON TERRITORY, CANADA. To most people "the Yukon," as this territory is generally called, means two things, gold and cold; and this popular opinion contains the two most important facts about the region. Before the discovery of rich placers of gold in the Klondike River region, in 1896, the Northwest Territories of Canada extended to Alaska. When the precious metal was found, thousands of prospectors poured in and a local government was needed to maintain order, for with the increased population it was no longer possible to administer justice from Ottawa, the capital of the Dominion. Consequently the Yukon, a region about one-third the size of Alaska, was organized as a territory, governed by a commissioner appointed by the governor-general in council. The commissioner is assisted by a council, consisting of three elected members. The people also choose a representative to the Canadian House of Commons.

The prosperity of the territory depends almost entirely upon the gold mines. At first the gold could be obtained by placer mining in the beds of creeks, but since the rich surface deposits have been exhausted it has been necessary to work the deposits more systematically and with expensive equipment. (*See* Mines and Mining.) This requires large capital for machinery and for labor, but is more effective than placer mining after the richer deposits have been worked. Since 1900 the output of gold has declined to about one-quarter of what it was in that year. As a result the population (now about 4,000) also declined almost 70 per cent in the next decade.

Today some attention is being paid to the copper deposits in the southern part of the territory, and if the gold production continues to decline, copper will probably in the future receive more attention.

In spite of the extremely cold long winters, when the thermometer often falls to 60° or 70° below zero, the inhabitants of the territory are able in summer to raise a part of their own food supply in the valleys between the high ranges of the Rockies. The summer is moderately warm, though the season is short, and as the sun shines for almost 20 hours a day, hardy grains and vegetables can be grown.

The rest of the food used in the territory is imported, coming in large quantities by the Lynn Canal and the White Pass and Yukon Railway to White Horse, the second town in the territory, and from there down the Yukon River to Dawson. The route of course is closed in the winter, but in the summer it is a delightful trip and one that is becoming popular with summer tourists to Alaska. Winter travel is almost entirely by dog sledges.

Z

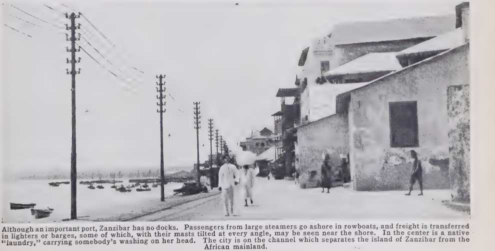
ZAMBEZI (*zăm-bē′zĭ*) **RIVER.** Although the lower region of the Zambezi, for at least 300 miles from its mouth, has nominally been in possession of the Portuguese since the beginning of the 16th century, it is only since the last half of the 19th century, through the reports of Livingstone and other explorers, that we have gained any definite knowledge of this vast region. We now know that the Zam′bezi is the fourth river in size in Africa, that it has a length of 2,200 miles, and that it rises in a black marshy bog in the northwestern part of what is now the British territory of Rhodesia, and flows south and east, discharging into the Indian Ocean. In its upper course the Zambezi flows through dense forests, alternating with an open bush country, with extensive stretches of flat country subject to widespread floods. At the eastward edge of the central plateau of Africa are located the Victoria Falls (*see* Victoria Falls), the greatest waterfall in the world. The Zambezi is navigable for stern-wheel steamers from the sea to beyond Tete, a distance of 400 miles; with the construction of locks here and there, more than 4,000 miles of navigable waters could be obtained.

ZAN′ZIBAR. "When you play on the flute at Zanzibar," says an Arab proverb, "all Africa as far as the lakes dances." This tiny speck of an island off the eastern coast, like the rivet in the handle of a fan, was long the point from which radiated Arab influence through a wide circle, from the land of the Somalis on the north to Africa's Niagara, the Victoria Falls of the Zambezi, on the south. All of that region was once, in a more or less haphazard way, the empire of the sultan of Muscat, who ruled from his capital on the coast of Arabia until his seat of government was transferred to Zanzibar in 1832. Thus the island naturally became a point of departure for European exploration, missionary labor, and commerce in the 19th century.

As you recline on a deck-chair in its busy harbor, with every kind of craft fussing back and forth, from French cargo-boats and British warships to Arab *dhows*, you sense something of the lure of the tropics, for Zanzibar lies only 6 degrees south of the Equator. Ashore white flat-roofed houses gleam in the noonday glare. The black spots you see are massive carved doors, heavy and lovely, shutting out the stifling heat and the outside world from cool interiors, to which Arab influence has brought splashing fountains and the seclusion of its womenkind. The bright vermilion patches are blossoming acacias which tower above high garden walls.

The streets are narrow and dirty, with Hindu money-lenders, Singhalese merchants, negro porters, fishermen, and half-castes cluttered together in amazing

ALONG THE WATERFRONT OF THE CITY OF ZANZIBAR



Although an important port, Zanzibar has no docks. Passengers from large steamers go ashore in rowboats, and freight is transferred in lighters or barges, some of which, with their masts tilted at every angle, may be seen near the shore. In the center is a native "laundry," carrying somebody's washing on her head. The city is on the channel which separates the island of Zanzibar from the African mainland.

confusion. One writer describes the city as "a cesspool of wickedness, oriental in its appearance, Mohammedan in its religion, Arabian in its morals, a fit capital for the Dark Continent."

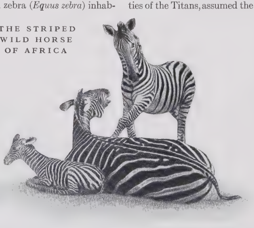
But so long as great "tuskers" roam the impenetrable forests of the interior, romance will cling to Zanzibar's skirts, for it is the great ivory port of the world. Piles of mellow deep cream shining tusks lie along the docks, waiting for the steamship to carry them to England. Here, too, are heaps of pleasant-smelling copra, the dried meat of the coconut, bound for Marseilles, and less alluring hides and skins. Countless bales are crammed with dried cloves—the brown flower-bud of a tall evergreen tree whose pungently fragrant fruit, first green, then bright red, is so inextricably bound up with the development of trade in the East. The bulk of the world's supply of cloves, indeed, now comes from Zanzibar and its sister island Pemba, just to the north.

The two islands, which have been independent of Muscat since 1856, are ruled by an Arab sultan, but they have been under British protection since 1890. The chief island is 48 miles long by 15 broad and is separated from the African coast by a channel 22 miles wide. With Pemba the area of the Zanzibar Protectorate is a little more than 1,000 square miles. Both islands are highly cultivated, clove plantations being the most important. The population is about 200,000; that of the city of Zanzibar about 35,000.

ZEBRA. This curious striped animal of Africa is a member of the horse family and is closely related to the wild ass. The mountain zebra (*Equus zebra*) inhabits mountainous regions in Cape Colony. Owing to the pursuit of hunters, it is scarce now and is fast being exterminated. It is about four feet high at the shoulders. Its general color is white, with black stripes on the body, legs, and tail. Those on the legs extend to the hoofs and those on the tail to the tuft of hair.

Burchell's zebra, found in the plains of South Africa, is a larger and more robust animal, with a longer mane and a fuller tail. Its general ground-color is pale yellowish brown. The broad stripes are dark brown or black, and do not extend so far on the limbs and on the tail as they do in the mountain zebra.

THE STRIPED WILD HORSE OF AFRICA



The Mountain Zebras, of which these are examples, roam the hill regions of South Africa. Hunted by the natives for their flesh, and by white men for their hides, which make fine leather, they are in great danger of becoming extinct.

Experiments have proved that the zebra can be made to work well in harness if properly treated, but it has never been truly domesticated. The flesh is eaten by the natives, and the hide is used for leather.

Burchell's zebra is often erroneously called the quagga. The true quagga, however, is a different animal which formerly abounded in herds on the plains south of the Vaal River but is now extinct. It was more like a horse and was of stouter build than the zebra, reddish brown in color, with dark stripes on the head, neck, and shoulders.

ZEBU (*zē'bū*). The humped ox of India, called by foreigners the zebu, is no longer found in the wild state, but has become thoroughly domesticated. It possesses a well-marked hump of fat on the shoulders, which is considered a delicacy for the table. It has long ears pointing downward and very short blunt horns. Zebus are used in plowing, for drawing carriages, and for riding; and the cows are milked. The sacred bulls of the Hindus belong to this species. Similar animals are found in China and in eastern Africa. Scientific name, *Bos indicus*.

ZEUS (*zūs*). The greatest of the deities in classical mythology was called Zeus by the Greeks, Jupiter or Jove by the Romans. He was the father of gods and men, protector of kings and supporter of law and order, the avenger of broken oaths and other offenses; he watched over the state and the family and over strangers and suppliants; his hand wielded the lightning and guided the stars; he ordained the changes of the seasons, and regulated the whole course of nature.

The son of Kronos and Rhea, Zeus, according to the ancient story, expelled his father and the older dynasties of the Titans, assumed the sovereignty of the world, and successfully resisted the attacks of the giants and the conspiracies of the gods (*see* Uranus). After the dethronement of the Titans, Zeus was allotted the empire of heaven and air, Hades (Pluto) of the infernal regions, and Poseidon (Neptune) of the sea, while the earth was left under the joint power of the three.

Zeus himself, however, was supreme over all. To his palace on Mount Olympus all the gods repaired to take counsel and to settle the affairs of men. The power and majesty of the ruler of the world is expressed in Homer's famous lines:

> Zeus spake, and nodded with his shadowy brows;
> Waved on the immortal head th' ambrosial locks,
> And all Olympus trembled at his nod.

The wife of Zeus was Hera (Juno), the queen of heaven, and their union was regarded as the divine type of all earthly marriage. It is true that, according to many of the myths, Zeus was not always faithful to Hera but had numerous other love affairs; some authorities explain this by the fact that to Zeus have been ascribed attributes and adventures properly belonging to other gods that came to be identified with him.

As judge and ruler Zeus was pictured as seated upon a throne, in his hand a scepter. As commander of the forces of nature he was represented as riding in his thunder-car, wearing the aegis or breastplate of stormcloud (sometimes worn also by Athena), hurling the thunder-bolt and the lightning scourge. To him the eagle, the mighty oak, and the mountain peaks were sacred.

The highest achievement in Greek sculpture was said to have been the statue of Zeus by Phidias. It was a colossal image of ivory and gold, 40 feet in height, occupying the place of honor in the great temple of Zeus at Olympia. Many descriptions of its splendor and beauty have come down to us, and its design is well known from its image stamped on certain Greek coins.

THE FATHER OF THE GODS

Zeus, or Jupiter as the Romans called him, was the chief god, the one omnipotent being, in classic mythology. He was regarded as the father of gods as well as of men. In fact his Latin name, Jupiter, means "Zeus the father" (*Zeus pater*).

ZINC. The medieval alchemist stood before the roaring furnace wherein he smelted from rocky ores the metals to be wrought by armorers into weapons and trappings for knights and soldiery. Darting hither and thither, faces ruddy in the eerie light, apprentices were drawing the fires from the furnace, while molten metal hissed in gigantic caldrons.

As the blaze smoldered to ashes, the alchemist examined the wall crevices of his furnace with eager interest. His keen eye detected a substance unknown to him—a bluish-white metal unlike the lead and copper for which he was treating the ores. This strange substance was zinc, distilled from stray traces intermixed in the copper and lead ores. It was the first time, so far as history tells, that the unalloyed metal had ever been seen.

Thus was unfolded one of the earliest recorded romances of chemistry. Georgius Agricola, a German alchemist or chemist, tells us of this discovery in graphic language in his work 'De Re Metallica' (1556), in which he describes his many years of experimenting in the depths of the Harz Mountains.

The romance of zinc in our own day is scarcely less stirring. At the outbreak of the World War of 1914–18, Germany controlled a large portion of the world's supply, and within a few months the Allies found themselves seriously handicapped; for brass (the alloy of copper and zinc) is used for cartridge and shell cases, for scientific instruments, and for many other military purposes. Rush orders for huge quantities of *spelter*, as refined zinc ore is known, soon stimulated production in the American fields about Joplin, Mo., and elsewhere, to an unprecedented point and many large fortunes were made.

By far the most important peace-time use of zinc is in galvanizing iron. Sheets of iron are immersed in molten zinc and then removed, so that a coat of zinc remains, protecting the metal from rust and corrosion. Sheet zinc has many uses: for roofing, lining air-tight packing cases for munitions and other articles of export, for kitchen utensils, toys, etc. Other important uses are in electric batteries, in photo-engraving, and for castings. Zinc is indispensable in the cyanide process of extracting gold and silver from low grade ores. White zinc oxide (zinc white) is a valuable pigment. A famous preparation for destroying warts is zinc chloride, which is a powerful caustic. Sulphate, oleate, carbonate, acetate, and stearate of zinc also are useful for medical or toilet compounds.

Although the alchemist Agricola was the first to obtain zinc in its pure form, he did not give the world its first knowledge of this important element. The Romans of the time of the Empire were familiar with the zinc ore we call smithsonite, which they fused with copper to make brass; and in the Middle Ages brass was in common use in the form of plates on monuments, engraved with a likeness of the buried person. These are the so-called monumental brasses which are still common in old European churches. Zinc has been smelted and used as a commercial product, without alloy, only since the middle of the 18th century, when the first zinc smelter was established in England.

Pure zinc is a bluish-white element of lustrous surface; when broken it exhibits a crystalline fracture. It melts at 786° F., and boils at about 1,832°. Zinc ores occur in several quarters of the globe, chiefly the United States, Germany, Belgium, Great Britain, Australia, and China. Canada also produces some zinc ores. In the United States, which is the largest producer of zinc, the ore occurs chiefly in the form called blende, a sulphide of zinc, and calamine, a hydrated silicate of zinc. Commercial zinc is produced by roasting the ore, thus setting free zinc oxide; then distilling the oxide with carbon in retorts.

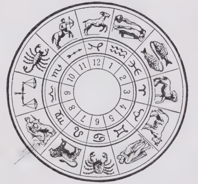
ZODIAC. The apparent annual path of the sun in the sky lies through 12 constellations or groups of stars, and the zone which these stars occupy is called the zodiac. Within this zone, likewise, are found the orbit of the moon and the paths of the principal planets. The zodiac was regarded with superstitious awe by the ancients, and the various movements of the sun, moon, and planets through the zodiac formed the basis upon which astrologers predicted the future and cast horoscopes. To make the list of constellations of the zodiac easy to remember, the following rhyme was invented:

The Ram, the Bull, the Heavenly Twins,
And next the Crab the Lion shines;
The Virgin, and the Scales,
The Scorpion, Archer, and the Goat,
The Man that Bears the Watering Pot,
And Fish with glittering tails.

Usually, however, they are known by their Latin names: Aries (Ram), Taurus (Bull), Gemini (the Twins), Cancer (Crab), Leo (Lion), Virgo (Virgin), Libra (the Balance, or Scales), Scorpio (Scorpion), Sagittarius (the Archer), Capricornus (Goat), Aquarius (the Water Bearer), and Pisces (the Fishes).

As a result of the shifting of the equinoxes, the sun is now a whole constellation behind the appropriate sign. For example, at the beginning of spring the sun is said to enter the sign of Aries, but as a matter of fact it is still in the constellation Pisces. Two thousand years ago, however, the signs and the constellations exactly corresponded, which will not again be the case for about 25,000 years. (*See also* Astronomy; Constellations.)

THE SIGNS OF THE ZODIAC



Beginning with Number 1, they are, in order—Water Bearer, Fishes, Ram, Bull, Twins, Crab, Lion, Virgin, Scales, Scorpion, Archer, and Goat. The symbols beneath each sign are those used in astronomy and astrology.

ZOLA (*zō'lȧ*), **ÉMILE** (1840–1902). In a certain sense this French novelist resembles those sages of ancient times who one day sat down to write into a book everything that was known in all the world. Zola's ambition did not quite swallow up the whole world, but he did set out to show the workings of the laws of heredity in human society, and to this end produced some 20 volumes composing the Rougon-Macquart series of novels. "Heredity has its laws, just as weight has," he declared, and in his novels he sought to show how a character who had inherited certain tendencies, and who was then placed in certain surroundings, must develop and flourish or perish according to the strength or weakness he had inherited and the circumstances about him. This was not such a new idea anyway; and unfortunately for his reputation, Zola selected chiefly those individuals whose inheritance was weak and vicious, and placed them in situations which only served to drag them through crime, baseness, and social mud, and to bring out the points the author wished to prove.

However, whether this series of novels is pleasing or not, it is great as a huge picture of the side of life it presents. There is a strong sense of great masses of people, a clear taking-off of events and customs, occasional beautiful descriptions, and much keen insight into the frailties and struggles of the human spirit. Zola, together with Flaubert, Daudet, the Goncourts, Fabre, and others, formed what is known as the "naturalist school" of French writers. That is, they tried to show life just as it is naturally, without any comment from themselves. But Zola at least, in showing people as passive animals, slaves of heredity and of their own weak nerves, brutal and base, does not draw a picture of life which everyone would call perfectly "natural." Some of his novels outside the Rougon-Macquart series, and his short stories and plays, are of a more agreeable type.

Zola was born in Paris, of a French mother and an Italian father, a distinguished civil engineer. He spent his boyhood at Aix, and was educated at Paris, where he failed to graduate from the *lycée*. While wandering through the Paris streets looking for employment, sometimes without two sous to jingle together in his pocket, he composed the beginnings of his first published work. Better days came when his abilities were recognized, as was speedily the case. In the latter part of his life he courageously defended the cause of Captain Dreyfus in that famous and disgraceful affair and probably did more than anyone else to right the wrong done that unhappy man; but for his writings on the subject he was for a time exiled by the guilty public officials, and some of his works were suppressed.

Zola's best known works are: 'Contes à Ninon' (1864); 'Thérèse Raquin' (a play), 1867; 'Les Heritiers Rabourdin' (The Rabourdin Heirs), a farce, 1874; the Rougon-Macquart series (1871-1893)—including 'L'Assommoir' (The Dramshop), 1877; 'Germinal' (1885); 'La Débâcle' (The Downfall), 1892; and many others; a trilogy, 'Les Trois villes' (The Three Cities), including 'Lourdes' (1894), 'Rome' (1896), 'Paris' (1898); and another series, 'Les Quatre evangiles' (The Four Gospels), including 'Fécondité' (Fruitfulness), 1899; 'Travail' (Labor), 1901, 'Vérité' (Truth), 1902. The last volume of this series was to have been called 'Justice', but it was never completed.

ZOÖLOGY. Animal life, from the amoeba up to man, is the subject of zoölogy, which is one of the two main divisions of the science of biology (*see* Biology). In the present-day study of zoölogy, attention has been directed from the external appearances of animals—as shape, color, differences in horns, hoofs, etc.—to their internal structure and life processes. An attempt is being made to analyze their vital activities and to determine their position in the history of the universe. So the zoölogist is no longer a mere collector and classifier of animal specimens. That which is best and strongest in modern zoölogy is being worked out in the laboratories by experiments and observations. These studies, especially in the last half-century, are leading to large generalizations regarding the science of life, which should become known to all people of liberal culture.

The Greek philosopher Aristotle (384–322 B.C.) has been called the "Father of Natural History," which includes zoölogy. He was a man of truly scientific mind and made many original observations on the structure and development of animal life. The Roman, Pliny the Elder (23–79 A.D.), also wrote on zoölogy; but he was less scientific, mixing borrowed facts, fancy, and fabulous stories with his own observations. The revival of anatomy by Vesalius in the 16th century (*see* Anatomy) greatly helped zoölogy by giving a knowledge of structure, the study of which was gradually extended downward from the higher animals to other forms, including the invertebrates, the study of comparative anatomy coming in due time. The development of the microscope, from the 17th century on, was of especial importance as an aid to the study of minute animal forms and structures.

The systematic classification of animals (as well as plants) owes much to the Swedish naturalist Linnaeus (1707–1778). The French zoölogist Buffon (1707–1788), who was a man of more philosophical mind than Linnaeus, created a popular interest in the subject by his graceful writings, and also opened up new fields and led the way in some matters of great importance. His countryman, Georges Cuvier (1769–1832), laid the foundation of the comparative study of the structure of animals (comparative morphology); and another countryman, Lamarck (1744–1829), was the most noteworthy of the predecessors of Darwin in the study of evolution. Microscopic study of animal tissues by Theodore Schwann (1810–1882) founded the science of histology and led to the establishment of the cell theory (*see* Cell). The study of embryology, or the development of the individual organism, was founded by von Baer (1792–1876); and at the same time the foundations of animal physiology were laid by Johannes Müller (1801–1858).

Zoölogy up to 1860 was thus the product of the concurrent growth of knowledge in regard to these subjects—the structure of animals (morphology), their development (embryology), and their vital activities (physiology). Then an additional element was introduced which has illuminated the whole field. This was the doctrine of organic evolution, as set forth by Darwin in 1859 (*see* Darwin, Charles Robert; Evolution). From that time to the present the study of zoölogy has been dominated by the idea of evolution, and animals and plants have been studied broadly—in the light of their ancestral history. Progress is dependent still upon advance in anatomy, physiology, and embryology, but the point of view from which the facts are considered has been changed. (*See* Animal Kingdom.)

The study of animal structure or morphology, together with microscopic anatomy (histology) and embryology, makes up what is called structural zoölogy. The general description and classification of animals is systematic zoölogy or taxonomy. The geographical distribution of animals has been widely studied and elevated to the rank of a special department. Standing coördinate with the great field of morphology is physiology, which, broadly speaking, concerns itself with the vital processes of all living organisms. Studies of the mental powers and the mental phenomena in animals lead to animal psychology, which may fairly be considered a part of zoölogy.

ZOROASTER. Far back in the misty past, perhaps a thousand years before the birth of Christ, when the ancestors of the Medes and the Persians were still a wandering shepherd people, a wise man named Zoroaster (also called Zarathustra) founded a new religion. By the flame of his genius he so transfused the old folk-legends and ceremonies of the ancient Iranians that from them emerged one of the noblest of the ancient religions. Called Zoroastrianism after its founder, this faith spread until, when the Persian empire was at its height, it was held by most of the inhabitants of western Asia and Asia Minor. Its followers have since dwindled until now they number only about 100,000, chiefly in India, where they are known as Parsees.

Seeing the ceaseless struggle going on in the world, Zoroaster thought of life as a battle, in which the forces of storm and sunshine, of good and evil, were struggling for the mastery. At the head of the forces of good he placed Ahura Mazda or Ormuzd, representing light, life, health and strength, truth, and all that is good. Ahriman represented darkness, the destructive forces of nature, death, deceit, evil of all kinds, like the Satan of the Hebrew and Christian religions. Ahura Mazda was aided by holy spirits or angels; while on the side of Ahriman were ranged evil demons. In the end Ahura Mazda would triumph; but every man, Zoroaster taught, must fight on one side or the other, and he will receive reward or punishment hereafter according to his choice.

Zoroastrianism was the first universal religion, as opposed to the purely national or tribal faiths of Egypt and the ancient Jews. From the start it aimed at converting men of all races, and thus became the first creed to work by missions. Fire, the purest of the elements and the symbol of the spirit, played an important part in its worship, though the followers of the pure religion, at least, were not really "Fire Worshippers," as they have sometimes been termed. Their doctrines and teachings, as embodied in their sacred book called the Avesta or Zend-Avesta, show that their ideal of religious and moral life was a high one. It is summed up in the phrase, "good thoughts, good words, good deeds."

The *magi* were the priestly and learned caste of the ancient Iranians, and Zoroaster laid down rigorous rules for their manner of life, which was to be of the simplest and severest type. But in the course of the centuries they fell from their high position and became mere strolling jugglers and soothsayers, and it is from the black arts they were supposed to practice that we get our word "magic." The name survived until the Christian era as designating learned men, especially astronomers, and the New Testament tells how three magi, or wise men of the East, came to worship at the manger where the infant Jesus lay.

After the time of Alexander the Great, Zoroastrianism gradually declined. It received its deathblow in the middle of the 7th century A.D. with the Mohammedan invasion, though in a few remote districts and in India it lingered on.

ZÜRICH (*zü'rĭk*), SWITZERLAND. Capital of the Swiss canton of the same name, most populous, most important, and on the whole the finest city of Switzerland, Zürich was until 1848 practically the capital of the Swiss Confederation. The city crowns very proudly both banks of the River Limmat as it issues from the lovely Lake of Zürich fed by the glaciers of the high Alps.

The older sections of the town are crowded, but the newer portions, stretching up the slope of the Zürichberg and along land reclaimed from the lake, are quite magnificent, with several splendid medieval churches and monasteries, the Swiss National Museum which contains a rare collection of antiquities and art treasures, the town library, the largest in Switzerland, the University of Zürich—for Zürich is the intellectual center of German-speaking Switzerland—many stately public buildings, and the imposing villas of the rich along the lake. A broad boulevard is the main artery of this quarter, its sides lined with shops comparing well with those of Paris.

Always wealthy and prosperous since it first became an important town early in the 11th century, Zürich is the banking center of Switzerland. The weaving of silk is the most important industry, but cotton-spinning and the manufacture of machinery are close rivals for first place.

With so many near neighbors, Italians, Austrians, Germans, and French, Zürich is distinctly cosmopolitan in population, with Germans predominating greatly. Its thoroughly delightful climate attracts many British and American travelers, and it has always been the favored refuge of Russian and Polish political exiles. The population of Zürich is about 207,000.

ZWINGLI (*tsvĭng'lē*), ULRICH (1484–1531). Zwingli was to the Protestant reformation in Switzerland what Luther was to the German. Although he was the son of a peasant, he escaped the hard material struggle which Luther experienced, and also his spiritual struggle. His views developed naturally and independently of those of Luther, largely under the influence of Erasmus, whose edition of the Greek text of the New Testament he studied constantly.

In 1518 he began his work as a reformer by an attack upon indulgences and pilgrimages. His appointment as preacher at the Cathedral of Zürich enabled him to secure a wider hearing for his views. After a public debate between Zwingli and his opponents, the magistrates of that canton gave their approval to his work. The more wealthy and populous cantons adopted the cause of the reformers, but the five "forest cantons" remained zealously Catholic.

Zwingli's reform was more sweeping than that of Luther, and introduced many of the features of later Puritanism—disuse of crucifixes, holy water, and organ music. Zwingli also went farther than Luther in his teaching concerning the Lord's Supper, with the result that Luther refused the hand of fellowship to the Swiss reformer.

Zwingli was slain in 1531 in the battle of Cappel fought between the Catholic and Protestant cantons of Switzerland. The peace which followed left each canton to do as it pleased in religious matters, and the division into Catholic and Protestant districts continues to this day much as it was in the years following Zwingli's death.

STUDY OUTLINES

Picture Lists, Guides to Good Books, Interest-Questions

IT often happens that information picked up in study and reading remains unorganized and disordered in our minds. We may remember many historical facts, for instance, without having a clear conception of their sequence and relative importance. Perhaps important connecting links are missing. If we could make a quick survey of the great periods of history—if we could pick up rapidly the missing fragments—all that we already know would fall into place, taking on a new meaning and a new usefulness.

Again, we may have an interest in certain subjects, such as Architecture, Biology, Economics, Music, which we never have time to study in detail, but which we want to grasp in their broad fundamental aspects to round out our education.

For such purposes the Study Outlines in this volume will prove invaluable. They will also be an ever-ready guide to the student who desires to carry out a detailed plan of work on a more ambitious scale.

These Outlines differ radically from the skeleton tables and reading courses so often found in textbooks and in the older type of reference works. They are much more than mere titles of articles or portions of articles arranged in table form. A glance through them will show you that their subdivisions consist for the most part of sentences and phrases which bring out the significance of each step and its relation to what precedes and what follows. It would be profitable, indeed, merely to read through many of these Outlines, even if you did not look up a single page reference.

With the Outlines are Picture Lists, indexing the most important pictures to be found in the encyclopedia on each subject. There are also Guides to Good Books, and groups of Interest-Questions designed to arouse curiosity and thus lead into the main volumes. A table of contents of this entire department appears below.

Study Outlines

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NATURE STUDY

DO YOU KNOW how to read in Nature's wonder book? It is the most fascinating book in the world, for it is made up of living stories, always changing, always new. It is a book full of adventure and excitement, crowded with tales of mystery in which you yourself play the part of detective. It is a puzzle game, in which answers pop up in the most amazing way and in the most unexpected places. Never can you get tired of this book, no matter how long you read it or how old you grow; for it is the Book of Earth which is your home, and the Book of Life which you live.

And how can you read in that marvelous book? Simply by keeping your eyes open! By watching! But you must learn what to see, what to look for. Two thousand years ago the wisest of men actually believed that particles of mud turned into young eels. And there are people today, right here in America, who think that if you soak a horse hair in the right kind of water, it will change into a worm. Many a South American savage who sees hundreds of caterpillars and butterflies every day of his life doesn't know that the two are really the same insect and that caterpillars turn into butterflies. Men make these blunders because they haven't learned to keep their eyes open.

This Outline on Nature Study is intended as an eye-opener. It will teach you to see for yourself, and to understand what you see. No matter what you do in life, you will profit immensely from the keen habit of observation you gain in this way. To see clearly and to understand what you see is the true evidence of the intelligent man.

NATURE STUDY

Preliminary Reading for Little Children

FOR little children, not yet old enough to begin Nature Study in a systematic way, the story method is the best introduction to the subject. Interested at first in the adventures of their animal heroes, they soon develop a desire to find out more about the animals themselves and the natural surroundings in which the animals live. The following stories, selected from the "Story Hour Tales" to be found in these volumes, will prove admirably suited to this purpose. While retaining the full imaginative flavor that appeals so directly to the child, they serve at the same time to bring out the principal characteristics and habits of the animals in question.

TALES THE WOODMAN TOLD

The Story of Johnny Bear: 351.
The Story of Fleetfoot, the Deer: 982.
Mogul, the Baby Elephant: 1128.
The Story of the Lynx with Wings: 2088.
Adventures of Howler, the Monkey: 2293.
How the Mouse Grew So Small: 2360.
How Mr. Rabbit Lost His Tail: 1586.
Mr. Coon Who Wouldn't Change His Mind: 2952.
Why the Tortoise Bites So Hard: 3564.
How the Whale Learned to Smoke: 3727.

OTHER ANIMAL STORIES

What the Crawfishes Had to Say for Themselves: 916.
The True Story of Jimmy, a Tame Crow: 927.
Greyfriars Bobby—The Story of a Dog: 1024.
Mr. Earthworm Tells His Own Story: 1067.
The Pigeon That Won a War Medal: 2806.
Mr. Fluffy Tail and Miss Curly Locks: 3335.

General Outline for Older Students

The following articles will provide the foundation for practical Nature Study. They will serve to outline its purpose and to suggest in a broad way the divisions of the subject and the kind of facts and problems with which the nature student deals. The articles in Sections II and III should at this time be read merely for their general interest value, the more technical portions to be passed over lightly. These articles will be reviewed more carefully in the later divisions on Botany and Zoölogy.

I. NATURE STUDY: 2407.
  A. A Wild Garden and Its Tenants: 2416.

II. PLANT LIFE: 2820.
  A. Lower Types of Plants: Bacteria 302; Algae 90; Fungi 1382; Lichens 1994; Moss 2338; Liverworts 2032; Ferns 1232.
  B. Flowers: 1304.
    a. The Life of a Flower: 1305.
  C. Trees: 3530.
    a. A Year in the Forest: 3534.
  D. Weeds: 3712; showing weeds as the "fighters" of the plant world.
  E. Water-Plants: 3700.

III. ANIMAL KINGDOM: 127.
  A. Amazing Instances of Animal Behavior: 130.
  B. Introduction to Some of the Commoner Animals:
    a. Lower Types: Amoeba 118; Worms 3813; Snails and Slugs 3255.
    b. Insects: 1781.
      1. Some Mysteries of Insect Life: 1789.
      2. Ant 139; Bee 359; Beetles 366; Butterflies and Moths 544; Caterpillars 660; Fly 1312; Grasshopper 1503; Wasps 3690; Water-Bugs 3696.
    c. Spiders: 3320.
    d. Fish: 1271.
      1. Principal Food Fishes of the World: 1278.
      2. Salmon 3113; Eel 1089.
    e. Frog: 1373; Toad: 3506.
    f. Lizards: 2035; Snakes: 3257; Turtle: 3562.
    g. Birds: 400.
      1. Leading Families Among Our Bird People: 413.
      2. Birds' Songs and Houses: 421.

h. Mammals: 2132.

1. Cattle 662; Horse 1682; Sheep 3198; Goat 1476; Hog 1670; Deer 979.
2. Hares and Rabbits 1583; Guinea-Pig 1548; Rat 2977; Mouse 2359; Muskrat 2384; Squirrel 3333; Chipmunk 752; Groundhog 1543; Gopher 1488; Prairie-Dog 2912; Porcupine 2883.
3. Cat 657; Dogs 1018; Fox 1336; Wolf 3774; Bear 349; Badger 303; Raccoon 2951; Skunk 3246; Mink 2251; Seal 3166.
4. Mole 2278; Hedgehog 1627.
5. Bat 345.
6. Monkey 2287.

Nature Study the Year Around

THERE are no fixed rules for Nature Study. You may begin anywhere, at any time. You may start with the whale and work down to the tiny bacteria, or you may go the other way around. You may start with animals or you may start with plants. Indeed, you needn't begin with living things at all. If you are a boy building things with wood, you notice that some wood is hard, some soft, some heavy, some light, some fine grained, some coarse. You wonder how this happens. You start to find out, and the first thing you know you are right in the middle of Nature Study. Or, if you are a girl, you notice the difference between sewing threads and between various kinds of cloth. Here again, if you are curious about the reasons, you will become a nature student whether you know it or not.

No matter where you begin, if you ask questions about the common everyday things of life, you will find yourself very quickly following the fascinating paths through Nature's great garden-menagerie. There are two important rules to follow in finding your way through these paths. First, begin with the animals and plants that are right around you, those that you can *see for yourself;* second, among those that are around you, choose at the outset the animals and plants that you like the best, for love of Nature and sympathy with Nature are essential.

Do not try to do too much. Among the experiments suggested, pick out a few and *carry them out to the end.* If you try to keep four or five different kinds of pets, take care of a flower garden, cultivate a vegetable patch, and make several different collections, all at the same time, you will not do any one thing well and so you will become dissatisfied. Pick out not more than one or two for each season, and leave the others until next year.

Fundamental Principles of Nature Study

While you are at work, always bear these two great thoughts in mind:

A. All Nature is a unit. Every part is connected with every other part. The plants you see around you depend on the kind of soil and climate you have; the animals depend upon the plants or upon other animals. No living thing can ever be entirely independent. Nature Study is the study of the marvelous adjustment in these fascinating relations.

B. Everything in Nature has a reason. The shape of every leaf, every flower, every seed, the form and color of every animal, the arrangement of their feet, their teeth, their fur, their feathers, the way every bird builds its nest, the way every creature looks after its young, every detail of structure and habit, large or small—all these things have a reason. Nature Study is the study of those reasons.

SPRING

GUIDING MOTIVE: Spring is the season of birth and awakening. Nature, after the Winter months of rest, is aroused to new and vigorous life.

PLANTS—

I. STUDY OF BUDS:

- **A. First Appearance:** Examine the trees of your neighborhood. See which ones bud first. Note the effect of a day of brilliant sunshine, a day of rain, a night of frost.
  - **a.** Read "A Year in the Forest—Spring" (3534) for suggestions.
- **B. How the Buds Develop:** Gather twigs of Maple (2138), Elm (1138), Linden (2018), Buckeye (523), or other budding trees of the neighborhood. Put them in water at home, using a fruit jar or wide-mouthed bottle. Set them where they will get plenty of sun every day; and watch carefully the development of the buds. See how the tiny leaves were curled in the bud. Note the difference between the young leaves and the young flowers.

Note: All good nature students keep notebooks. Each one usually works out his own system, according to his particular interests. But one very good plan is to have two small notebooks or a larger one divided into two parts—one for "Field Notes" and the other for "Experiments." The first will cover what you *see* on your trips outdoors; the second what you *do* at home. Before starting a field trip, try to have some definite plan in mind about what you intend to find and study, and make your notes along that line. Always set down the date of the trip and where you went. Don't try to write too much, just the most striking things. In your experiment notes you should go into greater detail. If you have to make or build anything, describe how you did it. The notes on experiments which extend over several days or weeks should all be kept together, showing the progress of the experiment from date to date. Whenever you get a chance, *make a drawing of what you see or do.* Drawing is far better than writing, for once you have drawn a thing you will never forget how it looks. Never mind if your first drawings seem crude; you'll be surprised how rapidly you improve with practice. And remember your notebooks are intended for your own benefit and pleasure, not for someone else. Never think of what others will say about them.

II. STUDY OF FLOWERS:

A. Spring Flowers: Watch for the appearance of the first Spring flowers. Can you think of a reason why trees usually bud in the Spring before the smaller flowering plants spring up from the ground? Which warms up first, the air or the ground?

B. Flower Calendar: It is a good plan to make a "flower calendar" in your field notes, dividing it into squares like an ordinary monthly calendar and writing the name of the Spring flowers in the squares with the dates when you first saw them.

C. Collecting Flowers: When Spring is well under way, collect as many different wild flowers as you can find in an afternoon's trip.

- **a.** When you get home, after carrying them in your warm hand, how do they look? How does the stem look? Do the flowers hold their heads up? What has happened to the leaves since you picked them?
- **b.** Now put them in water and watch carefully what happens. Have you ever come in from a long walk hot, tired, and thirsty? How did the first glass of cool water make you feel? Do the flowers remind you of that?
  - **1.** Put a few of the flowers into water stained with red ink or some other bright water color. The next day cut through the stem, half way up; examine the cut ends. What do they tell you about how flowers drink?
- **c.** See how many of the flowers you can name. Find out, if you can, the names of all the others by asking people who are familiar with flowers. Look up the names of the ones you like best in the Fact-Index at the end of this volume, and read about them on the pages indicated there. Make sketches of one or two in your field notes.

Note: One of the most fascinating ways of learning about wild flowers and weeds is to make a collection of dried specimens. This is very easy to do. Whenever you find a new kind, take it home, lay it out to suit your taste between two sheets of newspaper or other coarse-grained paper, put the sheets between two boards and set heavy weights, such as four or five bricks or a bucket full of sand, on the top board. Change the paper after 12 hours and again after 24 hours, so the plants will dry quickly and not lose their natural colors. When thoroughly dry, mount them on special sheets by pasting narrow loops of paper across the stems at suitable places. The special mounting paper should be fairly heavy and about 8 by 10 inches in size; smooth sections of light-brown wrapping paper will do very well. Make two heavy cardboard covers of the same size; cut a straight line almost through each cover about three quarters of an inch from one of the long edges, break each cardboard along that line, and paste heavy paper across the break on one side to form a hinge. Now punch two holes about 6 inches apart on the narrow side of each hinge, and make corresponding holes near the left-hand edge of each sheet on which a flower has been mounted. By passing strings through these holes and tying them, you have a bound "flower book," in which new pages can be inserted whenever necessary. Write the name of each flower on the page where it is pasted, together with any other interesting information you may gather about it from time to time.

III. THE PARTS OF A FLOWER: 1304, 474.

A. The important parts of a flower are the **Peduncle**, the **Sepals**, the **Petals**, the **Stamens** (each consisting of the **Filament** and the **Anther** which bears the **Pollen**), the **Pistil** (which consists of the **Ovary** containing the **Ovules**, the **Style**, and the **Stigma**).

- **a.** Do not try to memorize these names as you see them printed. Take a flower and examine it, pulling it apart if necessary, and *learn to recognize* the different parts when you see them. If you learn the purposes of things in Nature, it is not so important to know their technical names. But it will be *much easier for you* to think and observe correctly, and to describe things to others clearly, if you learn some of the commoner terms of science.
- **b.** Remember that the purpose of every flower is to develop seed. Fruit is, of course, just a special form of seed. The wonderful way in which the various parts of a flower carry out this purpose will form a part of your Summer studies of flowers.

IV. SPROUTING SEEDS: 3171.

A. Seed Structure: Get a handful of dry Lima Beans (347). Examine one of them carefully. Notice the small nub on the inner edge. That is the **Germ** or **Embryo.** Peel off the tough outer hull, called the **Seed-Coat** or **Testa.** Notice how the inside of the bean is divided into two halves, which are united only at the Germ. These halves are called the **Cotyledons.**

B. The Seed Comes to Life: Fill a small wooden box with rich moist soil. Plant a dozen of the beans a quarter of an inch deep, covering them quite firmly and marking with a matchstick where each is planted. Keep the soil moist, but not soaking.

- **a.** After two days, dig one of them up. What has happened to the Embryo? What has happened to the Seed-Coat? Dig another one up very carefully every other day and observe the development of the different parts, of the rootlet (called the Radicle), of the first small leaves (called Plumules), of the stem. Where are the Cotyledons now?

b. Note how long after planting the first stem appears above the ground. What part of the stem appears first? What shape is it? Remember that the root end is the anchor, and that the other side of the arch is pulling upward just as hard as it can. How soon does it manage to pull the Cotyledons and the Plumules out of the ground? What has happened to the Cotyledons all this time?

1. Bear in mind that the Cotyledons are simply storage houses for the Embryo's food. When we eat cooked beans, we are nourished by the food which was really intended to give the sprouting bean plant its first start in life.

2. Here is a simple way of testing this fact. The food stored in the Cotyledons is mostly starch. Iodine turns blue when it touches starch; the more starch there is, the deeper and darker the blue. Keeping that in mind, put a drop of weak solution of iodine on one of the Cotyledons when a bean first starts to sprout. Note the color. Now put a drop of iodine on a Cotyledon after a young bean plant has straightened up above the ground. What change do you notice, and what does it indicate?

3. An even simpler test is to remove the Cotyledons from one of the young plants a day after it appears above ground, and then compare its rate of growth with the others.

C. Differences in Seeds: Study the seeds of other plants. Plant seeds of Pea, Radish, Nasturtium, Millet, Corn, Pansy, Hollyhock, Sunflower, Cabbage, Tomato, or any other available variety, selecting a half-dozen as varied as possible in size and shape. Note how each behaves in sprouting. Has the size of the seed anything to do with the size of the sprout, or with the time it takes the sprout to appear? (Be sure to label with a bit of paper held in the split end of a match where each seed was planted, so you can identify the sprouts).

a. Notice that some seeds have only one Cotyledon. This is an important point in the scientific classification of plants, all the most highly developed plants and trees being grouped as either Monocotyledons (with one Cotyledon) or Dicotyledons (with two or more Cotyledons).

V. MAKING A HOME GARDEN: 1394.

A. Consult the table on page 1397 telling "What and When to Plant in the Vegetable Garden."

B. Remember that, in addition to the kitchen value of your vegetable garden, you, as a nature student, are interested in the actual lives of those vegetables. Learn to know them all, how they sprout, what their flowers are like, and other similar details.

C. While you are taking care of the garden, learn to know the *reason* for everything you do. Why must the soil be spaded and pulverized before seeding time? What harm do weeds do? What is the effect of too much moisture and of too little moisture? What are the chief enemies of your garden, besides weeds? Many of these things are brought out by the plant studies in the outline for Summer work.

ANIMALS—

You must connect plants and animals intimately in your thoughts about Nature. Remember that where there are no plants, there can be no permanent animal life. If all the plants in the world were to die, all the animals and the men, too, would die shortly afterwards. Plants are the original manufacturers of all food. Animals live upon this food, directly or indirectly. If some are able to exist as flesh-eaters, it is because they live upon others which eat vegetable food. It follows therefore, that the structure and habits of all animals are closely associated with the character of their plant neighbors.

I. FAMILIAR PETS: 2755.

Note: Begin your study of animals with those nearest to you. If you have pets of your own, begin with them; if not, study those of your neighbors or make friends with the owner of an animal store. This section on Pets and the following section on Farm and Barnyard Animals does not go into the many fascinating details of tricks and habits. Those things you will have no trouble in working out by yourself. These studies are intended to bring out some of the most striking points in the bodily structure of these familiar animals, points which you might perhaps overlook, but which illustrate the great fundamental law of *natural fitness*. By the use of intelligence, men train themselves to be fit for special tasks. But the fitness of animals for the many different lives they lead has been trained and developed through untold ages by Nature. While most domestic animals have been greatly changed in appearance by the long breeding carried on by men for their own purposes, these animals retain most of the forms, instincts, and habits that were so useful to their wild ancestors. A study of these forms and habits, therefore, will be most useful in helping you to work out problems of wild life. You might well give a separate section of your field notes to "Pets and Other Domestic Animals."

A. Dogs and Cats:

a. Examine a Dog and a Cat. Notice their teeth. How do their front teeth differ from yours? Observe the extraordinary length of the eye-teeth or "canine" teeth, which is characteristic of the carnivorous or flesh-eating animals. Do Dogs and Cats always eat meat now? Does a Cat behave in the same way when you give it a saucer of milk and when you give it a piece of meat?

b. Examine the claws of the Dog and Cat. How do they differ? Which are sharper and why? Can you hear the footsteps of a Dog across a bare floor? Can you hear the footsteps of a Cat?

c. **Look closely at the eyes of the Dog and Cat.** How do they differ? Hold the Cat so it faces a bright light and watch the pupils of its eyes. Now take it where the light is very faint, and see what happens to its pupils. Remember that Cats hunt mostly in dark places at night, and that their eyes are made to see things when the light is exceedingly faint.

d. **Compare the fur of the Dog and Cat.** Which do you think would be warmer? Remember that the wild members of the Dog family usually catch their prey by running it down; while the wild members of the Cat family lie in ambush, often for hours, and spring upon their prey unawares. If you had to run far, which would you rather have on, the Dog's fur or the Cat's fur? Which would you choose, if you had to lie in ambush?

B. Other Pets:

a. **Examine the front teeth of a Rabbit, a Guinea-Pig, a Mouse or Rat.** You must be careful with the last two so as not to be bitten. How do they differ from the teeth of the Cat and Dog? Look up the article "Rodents," page 3036.

b. **Bird Pets:** Gather as many interesting notes as you can about the habits of bird pets, such as Canaries, Parrots, and Pigeons. How do birds get along without teeth? Notice the arrangement of their claws. How many toes have they? How are they arranged for grasping a perch?

II. FARM AND BARNYARD ANIMALS: **Horse 1683; Cattle 662; Sheep 3198; Hog 1670; Goat 1476; Poultry 2908.**

Note: If you live in the country, you will have no trouble studying these animals; if you live in a city, you should seek opportunities for observations during your field trips.

A. Cattle, Sheep, and Goats:

a. **Watch these animals when they are feeding.** See how their long tongues gather up the grass. Do they stop to chew very much? Watch them when they are lying down after feeding. What are their jaws doing? This is one of the most remarkable habits in the whole animal kingdom. Read about it in the article on "Ruminants," page 3082.

b. **Notice the feet of Cattle, Sheep, and Goats.** How many toes have they? Look again and see if you can't see two more. Remember that nearly all Mammals, except Elephants, Bears, Monkeys, Men, and a few other groups, *walk on their toes*. Some walk on one toe, like the Horse; some on two toes, like the Cow; some on four toes like the Cat and Dog. In each case, traces of the remaining toe or toes are to be found higher up on the leg. The "hock" on the hind leg of a Cow or Horse is really the heel, while the "stifle" is the knee. What we call the "knee" on the front leg is really the wrist. Consult the picture and text on page 1682.

c. **Examine the teeth of Cattle, Sheep, and Goats.** How do they compare with those of Cats and Dogs? What have they in the place of front teeth on their upper jaws? Remember that the organs for eating and moving are usually the best indications of the habits of animals. If an animal is to survive, these, above all others, must be suited to their task.

B. Horse:

a. **Watch a Horse grazing.** Does it chew its food as it goes? If you have read the article on "Ruminants" mentioned above, you know why the ancestors of the Cows and others developed the extraordinary habit of chewing their cud. What quality has the Horse to make up for the fact that it doesn't chew its cud? Look at its legs. Are they more fitted for running than the legs of a cow? Remember that the big heavy Draft Horses have all been developed by man's breeding, and that Wild Horses are always light and fleet of foot.

C. Hog:

a. **Observe a Hog feeding.** When it wishes to turn over a bit of food to get a better bite, how does it behave? Examine the flat tough end of the Hog's snout. If it is not good tempered, beware of its bite. Its jaws are very powerful. The snout is like a strong sensitive finger. Throw down a single grain of corn, and see how quickly the Hog's nose picks it out. What peculiarity do you find about the teeth of the Boar?

D. Poultry:

a. **Compare the feet and beaks of Chickens and Ducks.** What is each best fitted for? Could a Hen's beak scoop through mud for food as well as a Duck's beak? How many toes has a Duck? How many has a Hen? Can a Duck roost on a broomstick? Can a Hen swim? These questions seem very simple, but if you think about them a little, they will emphasize the marvelous way in which Nature fits every creature for its particular kind of life.

b. **Try to be on hand when a Hen hatches her eggs, or watch the hatching in an incubator.** Notice particularly how bright and active the little chicks are as soon as they break out of the egg. Compare them to young Pigeons. Remember that Chickens are descended from birds which nested and spent most of their lives on the ground, where the young, if they were not quite spry from birth would be at the mercy of every chance foe. Pigeons, on the other hand, are descended from birds that built their nests in high inaccessible places, where the young were comparatively safe. With this in mind, what would you say about the habits of the Turkey's ancestors?

III. WILD BIRDS: 400, 413, 421.

A. Bird Calendar: Watch for the return of the birds which have been spending the winter in a warmer climate. Make a "bird calendar" similar to the flower calendar described on page 3849.

B. Bird Houses: Build small bird houses, following the suggestions given on page 425. Place them high up in trees near your home or on high posts. Do not, however, have them so close to houses that the birds are frightened away. Keep track in your notes of the time the birds take possession of the house, when and with what they build their nests inside. Egg-laying will begin soon after the birds stop bringing material for their nests. When the older birds begin bringing food to the houses, you will know the young are hatched. Note all of these details, but be careful not to disturb your feathered guests by too close inspection.

C. Field Notes on Birds:

- **a. Watch for birds' nests on your field trips.** Note the location of each with small sketch maps in your notebook, so you can return from time to time to watch the progress of the feathered families. Notice the size, shape, and color of the eggs. Do not yield, however, to the temptation to collect birds' eggs. A blown egg in a box at home soon becomes most uninteresting, while that same egg left in the nest will quickly turn into a most fascinating youngster, who may have much to teach you.
- **b. Try your hand at sketching some of your favorite birds.** Make sketches *from your personal observations*. There is little profit in copying someone else's drawings. Try filling in the outlines of the sketches with water colors.
- **c. Learn to identify birds by their song and their manner of flying as well as by their shape and color.** When you discover the name of a new bird, first find out all you can about it by yourself, then look it up in the Fact-Index at the end of this volume.

IV. THE LIFE OF STREAM AND POND:

A. Keeping an Aquarium: 162.

Note: One of the most delightful ways of studying nature is to keep an aquarium at home. You might begin modestly with a small fruit jar, or you may build for yourself one of the large oblong kind, with plate-glass sides cemented into a wooden or metal frame. If you have skill with tools, you will get most fun and profit making one of the latter, for then you can keep a greater variety of creatures and observe them better through the flat sides. Work out the plans yourself, remembering that it must be very strong to resist the weight of the water and that the joints must be very carefully made so they will remain water-tight. A good cement can be made as follows: Mix one part of white sand, one part of plaster of paris, one part of litharge, one-third part of powdered rosin, with enough boiled linseed oil to make a stiff paste. Fill the corner joints with this and allow a week for it to harden, then paint over the cement with a water-proof varnish, and let water soak in the aquarium for two or three days to wash out any impurities that might be left around the joints. If you intend to keep only two or three specimens at a time, a glass jar or bowl will do very well, but it should be as big around as possible in proportion to its depth, so that a large surface of water is presented to the air.

- **a. Plants for the Aquarium:** Gather enough sand to cover the bottom of your aquarium one inch deep at least. Wash the sand clean by stirring it up in a bucket with several changes of water. Go to the nearest wild pool or stream and gather small water-plants, taking a little of the mud or stones on which they are growing. Read the article on "Water-Plants," page 3700, and try to identify all the plants you collect. Arrange them in your aquarium, and let them alone for a few days.
- **b. Animals for the Aquarium:** Gather in a bucket or in glass jars any of the water creatures you find in the *same* place where you took the plants. For this purpose, a shallow net of strong mosquito netting, stretched on a cross-stick frame, will do very well. Just comb it through the water-plants or along the muddy bottom.
  1. Try to get some Water-Snails (3255), some of the smaller Water-Bugs (3696), some Crawfish (915), and one or two Minnows. These will be enough to start with. If you find strange insect-like creatures in your net which you cannot identify, place them with a few plants in separate jars. They will probably turn out to be insect larvae, such as the larvae of the Dragon-Fly, which are very fierce and would kill your other captives if placed in the same aquarium.
  2. If the water in your aquarium tends to become cloudy, you may have too many plants or too many animals. Change the water and try putting in or taking out a few more plants, and watch the result. Experiment in this way until the water remains clear without changing. Such an aquarium is said to be "balanced," the plants providing the oxygen that the animals need and the animals the gas (carbon dioxide) that the plants need. (Read the article on "Respiration," page 2998.)
  3. Cover the aquarium with cloth netting or wire screen to prevent such insects as Water-Boatmen and Water-Beetles from flying away. Always keep the water cold. Do not let direct rays of sun shine on the aquarium for long.
- **c. Raising Frogs and Toads:** Go to a pond where there are Frogs (1373) or Toads (3506) and collect their jelly-like eggs. Place these in the aquarium, and watch them develop. Note carefully the stages through which each one passes.

SUMMER

GUIDING MOTIVE: Summer is the season of greatest strength and activity. The animals and plants, born or awakened in the Spring, are busy with their countless tasks—growing, developing to maturity, preparing for the fruitful tasks of the Fall.

I. PLANTS AT WORK: Review in detail the "Plant Life" article from page 2823 to the last paragraph on page 2829.

- **A. Leaves: 1980.** Read this article carefully.
  - **a. Start a Collection of Leaves.** Follow the detailed directions given for the flower collection on page 3849. Be sure to identify each leaf, noting the principal points which distinguish it from other leaves. Look up the names of the trees or smaller plants to which they belong in the Fact-Index at the end of this volume, and read the references given there.

Note: Remember, in looking up the names of plants and animals, that they often have different popular names in different parts of the country. If you cannot find a certain name in the Fact-Index, consult a good dictionary and you will probably find that the plant or animal in question is more widely known under some other name, which will be the one used in these books.

  - **b. Leaves and Water:** Suspend a drinking glass mouth down over a well-watered growing plant, so that some of the leaves are imprisoned inside the glass. Leave it over night. What do you find on the inside of the glass in the morning? Where did it come from?
  - **c. Leaves and Light:** Place a house plant, like the Geranium (1435), in a room that has only one window. Examine it a week later. Which way are all the leaves facing? What must you do with a potted plant to make it keep its symmetrical shape in such a room?
- **B. Flowers: 1304.**
  - **a. Select a Few Common Flowers for Study.** Identify the different parts of each flower, as named on page 3849. Remember that these parts vary greatly in size, shape, and arrangement in different flowers. Some plants, such as the Begonia, have two different kinds of flowers: one which has Stamens but no Pistils, called the male or "staminate" flowers; and the other which has Pistils but no Stamens, called the female or "pistillate" flowers. In certain other plants, like the Hop, one plant will carry nothing but "staminate" flowers, while another plant will carry nothing but "pistillate" flowers. But in most of the common wild flowers, Pistils and Stamens are always found in the same blossoms.
    - **1.** Touch the Anther at the tip of the Stamen in one of your flowers with your moistened finger. Note the fine yellowish dust that comes off. That is the Pollen.
    - **2.** Read the following sections in "The Life of a Flower," beginning on page 1306: Sections 1, 7, 8, 14, 15, 16, 17, 18, and 19. Now cut your flower open carefully and see if you can find the Ovules which must be fertilized by the Pollen grains before a Seed can be formed.

II. INSECTS AND FLOWERS:

- **A. Color and Scent of Flowers:**
  - **a.** Bear in mind that the qualities we love most in flowers—their brilliant tints and sweet perfumes—are not really intended for our pleasure at all. They have a very business-like purpose, which you have already read about perhaps on page 1304 and page 2827.
  - **b.** Remembering this, go out into the country on a warm sunny day and watch the behavior of Bees, Butterflies, and other insects which hover or crawl about the wild flowers. Examine one of the flowers. Could a Bee reach the honey nectar in that flower without touching the Anthers and rubbing off some of the Pollen on its hairy coat? Could that same Bee then visit another flower of the same kind without dropping some of those clinging Pollen grains on the Stigma of that flower?
    - **1.** Why shouldn't each flower always pollinate itself, that is, drop the Pollen from its own Anthers upon its own Stigmas, and so produce its own seed? This happens often, of course, but under Nature's general laws of heredity, cross-breeding is necessary from time to time for all higher forms of life if the vigor and health of the offspring are to be maintained. It is this cross-breeding which the insects carry on unconsciously as they fly from flower to flower.
    - **2.** Compare a white flower and a red flower by daylight. Which is most conspicuous? Which is most conspicuous at night? Which of the two do you think would be pollinated by night-flying insects such as Moths? (See page 2408, last picture in the second row.)

III. FLOWERS AND THE WIND:

- **A. Some Queer Kinds of Flowers:**
  - **a.** Find a Pine Tree early in the Summer when the Catkins are well developed. Shake its branches, and watch the yellow dust come down. Now examine the young cone buds, and you will find many of them covered with this yellow dust. Which is the male flower and which the female flower of the Pine? Do flowers always have Petals?
  - **b.** How is the Pollen dust carried to the cone buds, since the Pine flowers don't attract insects? Do you think the wind is as good a carrier as the insects? Which would waste the most Pollen?
  - **c.** How many other trees do you know which have flowers without Petals, like the Pine?

IV. SEED PRODUCTION:

- **A. The Transformation of the Flower:**
  - **a.** Watch a flower as it fades. What happens to the Petals? Poets often speak of the "tragic death of a flower." Is it really death? Isn't it rather a transformation into new life—the life of the seed? From the point of view of the plant, the purpose of the flower is simply to produce the seed.

- **b.** Make notes of the seed development on the trees and other plants of your neighborhood. What kind of seeds do we call Fruits? What kind of seeds do we call Nuts? How are the seeds of Peas and Beans produced from the flowers?
- **c.** Where are the seeds of the Pine produced? How do flowerless plants, like Ferns, reproduce themselves? Examine the under side of Fern leaves, then read the article on Ferns, page 1232.

V. WHAT PLANTS NEED TO LIVE:

A. Light:

- **a.** Plant a half-dozen Lima Beans in a box or flower pot and put it in a dark place. Give them all the water they need. What color are the young plants after they have straightened up? How long do they live?

B. Water:

- **a.** Plant three separate colonies of Lima Beans. Keep one colony soaked with water; keep the second colony moderately damp; and give the third colony no water at all. Compare the results.

C. Air:

- **a.** Plant some Lima Beans inside a fruit jar and keep the top screwed on tight. You will not have to water them, since no water evaporates. Watch what happens.

D. Minerals:

- **a.** Turn to page 2821, look at the picture entitled "Why Plants Get Sick," and read the text under the picture. This explains why you have to put fertilizer in fields and garden soil after several crops have been grown. Read also the article on Fertilizers, page 1235.

VI. INSECTS AT WORK:

A. What is an Insect?

- **a. How many legs has a Fly?** a Grasshopper? a Bee? a June Bug? a Mosquito? a Dragon Fly? an Ant? —Look up the word *Hexapods* in the Fact-Index, and you will find a sure way of identifying all insects.
- **b. How many legs has a Spider?** Is it an insect?
- **c. Read the Section "How Insects are Made" on page 1787.**

B. Social Insects:

- **a. Read the following articles:** Ant, 139; Bee, 359; Wasps, 3690.
- **b. Studying Ants at Home:** Get a large fruit jar of the thinnest clearest glass you can obtain. Fill it two-thirds full of moderately damp earth—a soil containing quite a little sand is best. Find a nest of Ants, any one of the smaller varieties that build in the ground, and capture its inhabitants. A good way to do this is to scoop up the whole nest with a garden trowel and spread out the scooped up earth carefully on a smooth piece of ground, using a small paper cone with which to pick up the Ants and dump them into an empty fruit jar. Be careful not to injure them. Pick up all the larvae and pupae you see. The former look like small white worms, the latter like grains of wheat. Also search carefully for the queen, which you will recognize by her greater size.
    1. Carry all your captives home and transfer them to the fruit jar which contains the earth. Fasten over the top a fine screen or a paper punched full of large pin holes. Now make a cylinder of heavy black or dark brown paper so it will fit snugly around the outside of the jar, yet be free to slide up and down when you wish it. Put a little sugar, some bits of raw apple, or some tiny pieces of meat in the jar, and set it aside in a window corner, where there is not too much sun, leaving it until you see the Ants have built themselves a new nest.
    2. Now slide the paper cylinder down, and you will find the Ants have made most of their galleries down the sides, just inside the glass. They have taken advantage of the fact that the glass offers them support for one side of their tunnels. You may watch the structure of the tunnels for a few seconds, but do not leave them exposed to the light too long, or the Ants will abandon those tunnels and dig in out of sight.
    3. Make notes on the way the Ants work, how they eat, how they look after their young, etc. Do not try to recruit your colony by putting in Ants captured from other nests, for these will probably be killed at once by the first settlers. If you wish more Ants, gather only larvae and pupae. These will be welcomed, cared for, and brought up most cheerfully. If at any time the earth seems to be drying up, scatter a few drops of water inside the jar.

C. **Insect Transformation:** Read "In the Fairyland of Change," page 1785.

- **a. Caddis Flies:** If you have not already started an aquarium as described on page 3852, it would be well to do so now. Go out to the nearest pond and examine the shallow water near the edges. If you look long enough you will probably see some small bundles of criss-crossed sticks, which move about in a mysterious way. Scoop a few up and carry them home in a jar full of water, and put them in your aquarium. They are the larvae of Caddis Flies (see page 1786). In time they will turn into pupae and then, a little later, they will emerge from the water with wings.
- **b. Butterflies and Moths:** Find a Caterpillar with a smooth skin and one with a hairy skin. Take them home together with the leafy twigs or stalks of the plant on which you found each of them feeding. Fill a shallow box with earth and thrust the twigs upright into it, and place the caterpillars on the leaves. Now cover over each of the twigs with a large lamp chimney, pressing the bottom into the soil and covering the top with mosquito netting or other cloth that will let air through. A frame covered with netting will often do as well as the lamp chimney. The caterpillars

should get plenty of light, but not the hot direct rays of the sun. They will soon turn into pupae. If the leaves on the twigs wither, get more twigs of the same kind.

1. Note which one builds a cocoon—the hairy Caterpillar or the smooth one. Which one turns into a Moth and which one into a Butterfly?
2. Read the article "Butterflies and Moths," page 544.
3. Find out the names of your Moth and Butterfly, and look them up in the Fact-Index.

c. **Mosquitoes:** Gather Mosquito eggs, which you will find floating in masses like tiny rafts on the surface of stagnant pools. Or you may capture a few "wrigglers," as the Mosquito larvae are called. You will recognize eggs and "wrigglers" from the pictures on page 2335. Carry them home in a small bucket or fruit jar two-thirds full of water, set them in a shady window, and watch them develop. Do not put them in your aquarium, for they would probably be eaten up by your other guests.

1. Now collect another batch, and as soon as the "wrigglers" are most active, pour a few drops of coal oil on the surface of the water. What happens to the "wrigglers"? Does this suggest to you how to get rid of Mosquitoes in any neighborhood?

VII. BIRDS AT WORK:

A. Bird Survey:

a. **Make a list of the Summer birds living in your neighborhood.** See how many you can add to your list from personal observation. Note in each case the following points:

1. Size and coloring.
2. Song or cry.
3. Where and how they build nests, and the color and shape of their eggs.
4. What they eat—whether insects and worms, or seeds and fruits, or mixed diet. This will require careful observation.

B. Feathers:

a. **Examine all the bird feathers you can find.** What are the soft downy feathers for? What are the stiff smooth feathers for? What else besides flying? Do you think they would shed water as well as the shingles on a roof?

1. Cut up a feather. What do you find inside the quill? Do you think that men could manufacture anything which, for its weight, would be as strong and springy as a feather?
2. Pull apart the "barbs" which make up the flat part or "vane" of the feather. Do they cling together? If you have a magnifying glass, examine the structure of these barbs.
3. Read the article on "Feathers," page 1228.

VIII. FARM ANIMALS AT WORK:

A. Varieties of Farm Animals:

a. **Physical Appearance:** List as many different breeds of Horses, Cattle, Sheep, Goats, Pigs, and Poultry as you can find to observe in your field trips. Note particularly their chief distinguishing characteristics, such as size, shape, and color.

b. **Useful Qualities:** Find out the special value of each breed of farm animals, and the points about each which make it serve its purpose effectively.

FALL

GUIDING MOTIVE: Fall is the season of fruitfulness. Plants, which have reached maturity or gained new vitality in the summer months, now put forth their seeds and fruit. New generations of animals are growing up. All of Nature is busy preparing for Winter.

I. SEEDS AND SPORES: **3171.**

A. Seeds:

a. **Make a Collection of Seeds:** Gather seeds from all the plants you can find in your neighborhood. Note how the seed containers are fastened to the plant.

1. With the article on page 3171 as your guide, list the seeds which are intended simply to fall to the ground, those which are transported by the wind, those which have hooks or barbs to cling to animal carriers.
2. Examine each variety of seed and see if you can tell which are Monocotyledons and which are Dicotyledons. (Refer back to the section on "Sprouting Seeds" of this Outline—page 3849.)

b. **Select Seeds for Next Spring:** Pick out the seeds of the flowers you like best and wrap them in labelled packages to be planted next year. Keep them in a cool dry place.

c. **Fruit.** Read the last paragraph on "Fruit Growing," page 1380.

—Remember that what we call "Fruit" consists simply of seeds enclosed in a pulp which is intended to induce animals to swallow the seeds and drop them again far away from the parent plant.

B. Spores:

a. **Ferns as Examples of Spore-bearing Plants: 1232.** Examine the under side of Fern leaves or "fronds" until you find one covered with little brown dots. These are the "spore cases." What is the difference between Seeds and Spores? (Page 3173.) Do Ferns have Flowers? Remember the purpose of Flowers (page 2827).

b. **Other Spore-Bearers: Mushrooms 2374; Liverworts 2032; Moss 2338.**

II. HOW PLANTS GROW:

- A. **Trees as Examples of Growth: 3530.**
  - a. **Examine a Fresh Tree Stump:** Note the rings in the wood. You can tell the age of the tree by counting those rings. Which is harder and tougher, the heart-wood near the center or the sap-wood near the bark? Peel off the outer bark and see if you can identify the Cambium. Use the picture on page 3531 as a guide.
  - b. **How Sap Circulates:** Select on a growing tree a small branch which may be destroyed without harm. With a sharp knife cut off a narrow ring of bark, so as to leave a bare strip completely encircling the branch. Be sure you cut through the Cambium to the woody fiber. Now watch that branch from day to day. Before long it will die from the ring to the tip. What do you learn from that about the circulation of the life-giving Sap?
  - c. **Leaves and Their Work:** If the leaves are stripped from a plant it will stop growing, and if the stripping continues for long, the plant will die. Why is this? Review the article on "Leaves," page 1980, and read again pages 2823 and 2824 of "Plant Life."
    - **1.** Crush a leaf in your fingers. Can you see the green coloring matter (chlorophyll) separating itself from the pulp?
    - **2.** What kinds of plants can you find that are not green? Read the articles on Fungi (1382), and Mushrooms (2374). Do you know now why Mushrooms can be grown in dark cellars, where green plants would die?
  - d. **Autumn Foliage:** Notice when the leaves in your neighborhood begin to change colors in the Fall. How many different colors can you find? Gather leaves from the different trees of your neighborhood after they have changed color, and put them with the Summer leaves in your collection (page 3853).
    - **1.** What happens to the Chlorophyll when the leaves change color? (Page 1981.) Remember in this connection that, in the Winter when the leaves are gone, the trees stop growing.
    - **2.** Notice, after a leaf falls, how the tree has closed up the place where it grew.
  - e. **Roots and Their Work:** Dig out any small plant, taking up plenty of soil with it. Now wash off the soil so as not to injure the roots. Examine the fine root hairs. Read the article on "Root," page 3063, and consult the picture on page 2824.
    - **1.** Read about the remarkable process of "Osmosis" on pages 2825 and 2826, and if possible perform the interesting experiment shown in the lower picture on page 2823.
    - **2.** Study upper picture on page 2821, then read the article on "Fertilizers," page 1235.
    - **3.** Are the underground parts of plants always roots? Read "Bulbs, Tubers, and Rootstocks," page 532, and plant bulbs of Chinese Lily, Jonquil, Hyacinth, and Narcissus in flower pots indoors. Plant a Potato, after counting the "eyes," and see how many stalks spring up.

III. ANIMAL STUDIES:

- A. **Some Unpopular Creatures of the Roadsides:**
  - a. **Spiders and Their Webs: 3320.**
    - **1.** Find a Spider web near by. Throw a small twig against it. Does the Spider run out? Make a drawing of the web pattern. Now poke a hole in the web with a stick. Come back the next day, and you will probably find the web mended. Notice by comparison with your drawing how the patch was put in.
    - **2.** Notice the difference between the spiral threads and the coarser cross-threads of the web. Which threads are elastic and which rigid? Which threads stick to your finger when you touch them? Can you think why it would help the Spider to have some of the threads elastic and sticky, and others rigid and not sticky?
    - **3.** Study the remarkable structure of the Spider from the pictures on page 3323.
  - b. **Snakes: 3257.**
    - **1.** Remember that there are in the United States only four kinds of poisonous Snakes—Rattlesnakes, Moccasins, Copperheads, and Coral Snakes. The other snakes are not only harmless, but usually do a great deal of good to the farmer by devouring vermin.
    - **2.** You may examine a common Garter Snake without fear. Note the absence of eyelids. See how the scales on the under side are arranged for catching in the ground and pulling the Snake along. You can feel those little scales pulling if you let the Snake crawl over your hand.

IV. ANIMAL PREPARATIONS FOR THE WINTER:

- A. **Storing Away Food:**
  - a. **Outside Storage:** Watch a Squirrel during the Fall months. Throw nuts where it can find them. What does the Squirrel do with these nuts? Do you think it will be able to find them all when Winter comes? (3333)
  - b. **Inside Storage:** If you can catch sight of a Groundhog or Woodchuck in the Fall, you will notice how very fat it is. It is storing its Winter's food inside its body in the form of fat. You often see Squirrels in the Winter. Do you ever see Groundhogs? (1543)
  - c. **What other animals do you know that hibernate? (1646)**
- B. **Migration: 2231.**
  - a. **Birds:** Watch during the Fall months for the southward migration of birds. What kinds leave your neighborhood? What kinds pass through your neighborhood from the north?
  - b. **Other types of Migration: Eel 1089; Salmon 3113.**

WINTER

GUIDING MOTIVE: Winter is the season of rest. Most of Nature lies dormant awaiting the call of Spring to burst forth into new life. For those animals which neither migrate nor sleep through this season, Winter is often a period of hard struggle and hunger.

I. HOUSE PLANTS:

- A. **Varieties of Plants that Thrive Indoors:**
  - a. **Visit a Greenhouse:** What is the temperature inside? Notice the moisture of the air. What causes this? Make a list of the plants that thrive best in this atmosphere.
  - b. **Origin of Greenhouse Plants:** Find out the natural home of the various types of plants grown in greenhouses. Read up the article on such plants as Fuchsia (1381), Begonia (371), Hyacinth (1706), Orchid (2593).
  - c. **How Science "creates" new plants:** Many varieties of domestic flowers are not to be found at all in a wild state. They are specially developed under artificial conditions. Read "Burbank," page 538, and page 2830 of "Plant Life." Read also the second and third paragraphs of "Fruits and Fruit Growing," page 1377.

Note: Most of the cultivated plants have undergone such great changes at the hands of man that they cannot live at all in a wild state. They require constant protection against weather and natural enemies. The article on "Weeds," page 3712, brings out the contrast between the pampered plants that we raise for our own profit and pleasure and the independent plant "fighters" which survive and flourish entirely through their own efforts.

- B. **Care of House Plants:**
  - a. **Select a Few Favorite Plants:** See that they have plenty of good rich soil and that the pots are large enough to allow for the growth of their roots.
  - b. **The Varying Needs of Plants:** Different plants require different treatment. Some flourish best with abundant sunlight, others require more shade. Some absorb great quantities of water, others are injured by too much moisture. Study the habits of your plants and inquire of greenhouse gardeners about their care. Keep notes on your plants, putting down the date you set them out, their growth and development, and, if they have flowers, the period of blossoming.

II. OUTDOOR PLANTS IN WINTER:

- A. **Evergreens: 1208.**
  - a. **Cone-bearing Trees (conifers): 3539.** Make a list in your notes of all the cone-bearing trees you can find in your neighborhood. Read the following articles: Pine 2807; Spruce 3332; Hemlock 1629; Fir 1248; Cedar 670; Cypress 946; Sequoia 3175; Juniper 1902; Yew 3830.
    - **1.** Some cone-bearing trees shed their needles in the Winter: Larch 1962.
    - **2.** Learn to distinguish the different kinds of cone-bearers. Avoid the common mistake of calling the Spruces, Firs, Cedars, etc., "Pine trees." Do the true Pines make good Christmas trees? Which of the cone-bearers is best for this purpose?
  - b. **Other Evergreens:** Holly 1673; Laurel 1970.
- B. **Trees which Lose Their Leaves (deciduous):**
  - a. **Bark Formation:** Winter gives you an opportunity to learn to know trees by their bark. Study the trees of your neighborhood until you can recognize them in this way. In your leaf collection (see page 3853) make sketches of the bark of the tree to which each leaf belongs.
  - b. **Arrangement of Branches:** Note that the shape and arrangement of branches differ in nearly all species of trees. An interesting experiment for winter field trips consists in guessing the names of trees from a distance, judging merely from the appearance of the branches against the sky, then verifying your guesses by closer inspection of the bark or dead leaves.
  - c. **Winter Sleep of Plants:** Learn to distinguish annuals, biennials, and perennials (2830). Note that nearly all plants whose *seeds* are used for food are *annuals*, such as corn, oats, beans, peas. Nearly all plants whose *roots* or *leaves* are used for food are biennials, such as carrots, turnips, beets, and cabbages. In the first case the parent throws all of its strength into the seed and dies; in the second the first year's strength is thrown into root, stem, or leaf.

III. PLANT PRODUCTS: 2830.

- A. **Wood:**
  - a. **Household Articles:** Make a list of all ordinary household articles which are made of wood.
  - b. **Wood Structure:** Learn to recognize the varieties of wood by the grain. What causes the grain? (3532 and picture, 3531). Examine a warped board. Which way does the board curve in relation to the grain? Remember that the younger wood always shrinks more than the older wood. Boards, therefore, always curve toward what would have been the "outside" of the tree. Quarter-sawed wood, being cut so as to show the edge of the grain, is much less likely to warp.
- B. **Cellulose: 673.**
  - —Make a list of all the ordinary household articles which are made from plant-fiber products.

IV. FOOD: 1320.

- A. **Visit a Grocery Store:** Make a list of all the principal foods, dividing them according to their origin—"Vegetable" or "Animal."
  - a. **Vegetable Foods:** List separately the vegetable foods that are derived from seeds, fruits, roots, stalks, leaves, flowers.
  - b. **Animal Foods:** What principal animal foods are derived from living animals?

V. CLOTHING: 805.
- A. Origin of Cloth:
  - a. Vegetable: Cotton 901; Linen 2018; Flax 1291.
  - b. Animal: Wool 3782; Silk 3234.
    - —Does the Clothes-Moth eat cloth of vegetable or of animal origin?
- B. Other Materials Used in Clothing.
  - a. Leather 1975; Hair 1559; Furs 1389; Feathers 1228.
  - b. Bone 452; Ivory 1853; Shell 3200; Celluloid 672.

Picture Aids to Nature Study

NEXT to "seeing things for yourself," the most effective and fascinating way of studying Nature is through good pictures. The pictures listed here are particularly suited to this purpose. They are chosen from the hundreds of Nature illustrations in these volumes because they deal, for the most part, with the broad principles and general aspects of the subject. In addition to those in the list, pictures of almost all the common trees and flowers, of the most important birds and other animals will be found with their proper articles.

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How Birds Practice Camouflage 411.
Some Prominent Families of "Quack Land" 1045.
Distinguished Members of the Owl Family 2606.
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Books for the Nature Student

FIRST AND SECOND GRADES

Picture Book of Baby Beasts. F. E. Dugdale.
Buds, Stems and Roots. Annie Chase.
Little Nature Studies for Little People. Adapted from Burroughs by M. E. Burt.
Familiar Animals and Their Wild Kindred. John Monteith.
Little Flower Folks. M. M. Pratt.
The Plant Baby and Its Friends. K. L. Brown.
Stories Mother Nature Told Her Children. Jane Andrews.
Friends in Feathers and Furs, and Other Neighbors. James Johonnot.
Short Stories of Our Shy Neighbors. M. A. Kelly.
Stories of Plant Life. Florence Bass.
Nature Stories for Young Readers. Florence Bass.
Sea-side and Wayside—Vols. I, II. Mrs. Julia McNair Wright.
Four Feet, Two Feet and No Feet. Laura E. Richards.
All the Year Round—3 vols. Frances L. Strong.
All the Year Round—Vol. 4 (Summer). M. A. L. Lane and Margaret. Lane.
Eyes and No Eyes.—Arabella B. Buckley.

STORIES AND POEMS

Bed Time Story Book. Thornton W. Burgess.
Nature Myths and Stories for Little People. F. J. Cooke.
Bow-Wow and Mew-Mew. G. M. Craik.
So-Fat and Mew-Mew. G. M. Craik.
Book of Nature Myths. Florence Holbrook.
Little Stories of Little Animals for Little People. Susan Holton.
Nature Myths of Many Lands. F. V. Farmer.
Cat Tales and Other Tales. M. H. Howliston.

THIRD TO SIXTH GRADES

Bird Stories from Burroughs. John Burroughs.
Birds and Bees, Sharp Eyes and Other Papers. John Burroughs.
Birds that Every Child Should Know. Nellie B. Doubleday.
Little Brothers of the Air. Olive Thorne Miller.
First Studies of Plant Life. G. F. Atkinson.
Plants and Their Children. Mrs. William Starr Dana.
Little Flower People. G. E. Hale.
Wild Flower Book for Young People. Alice Lounsberry
Flowers and Their Friends. M. W. Morley.
Wild Flowers Every Child Should Know. F. W. Stack.
Mother Nature's Children. A. W. Gould.
Boys' Out-Door Vacation Book. A. H. Verrill.
First Lessons with Plants. L. H. Bailey.
How Plants Grow. Asa Gray.
Trees that Every Child Should Know. J. E. Rogers.
Ten Common Trees. Susan Stokes.
Stories of Animal Life. Florence Bass.
Little Beasts of Field and Wood. W. E. Cram.
Little People and Their Homes in Meadows, Woods, and Water. S. L. Hook.
True Tales of Birds and Beasts. David Starr Jordan.
Little Folks in Feathers and Furs. Olive Thorne Miller.
Among the Forest People. C. D. Pierson.
Among the Farm Yard People. C. E. Pierson.
Sea-side and Wayside—Vols. III, IV. Mrs. Julia McNair Wright.
Harold's First Discoveries. John Winthrop Troeger.
First Lessons in Natural History. Mrs. Elizabeth Cary Agassiz.
First Book of Birds. Olive Thorne Miller.
Little Brothers of the Air. Olive Thorne Miller.
Little Wanderers. Margaret Warner Morley.
Bee People. Margaret Warner Morley.
Stories of Insect Life. Clarence Moores Weed and M. E. Murtfeldt.
Seed Travellers. Clarence Moores Weed.
Seed Dispersal. William James Beal.
Neighbors with Wings and Fins. James Johonnot.
Neighbors with Claws and Hoofs and Their Kin. James Johonnot.
Some Curious Flyers, Creepers and Swimmers. James Johonnot.
The Spinner Family. Alice Jean Patterson.
The Prince and His Ants. Luigi Bertelli.
Our Humble Helpers. Jean Henri Fabre.
Story-book of Science. Jean Henri Fabre.
Secrets of Everyday Things. Jean Henri Fabre.

STORIES AND POEMS

A Hundred Anecdotes of Animals. P. J. Billinghurst.
Mr. Rabbit at Home. Joel Chandler Harris.
Just So Stories. Rudyard Kipling.
Crag and Johnny Bear. Ernest Thompson Seton.
Lives of the Hunted. Ernest Thompson Seton.
Black Beauty. Anna Sewell.
Nature in Verse. Edited by M. I. Lovejoy.
Poetry of the Seasons. Edited by M. I. Lovejoy.
Songs of the Tree-top and Meadow. Edited by A. S. Cook and L. B. McMurray.

SEVENTH AND EIGHTH GRADES

Bird Houses and How to Build Them. Ned Dearborn.
Bird Life. F. M. Chapman.
Bird Ways. Olive Thorne Miller.
How to Attract the Birds. Nellie B. Doubleday.
How to Know the Wild Flowers. Mrs. William Starr Dana.
The Whole Year Round. Dallas Lore Sharp.
A Book of Wood-Craft. Ernest Thompson Seton.
Nature Studies on the Farm. C. A. Keffer.
First Book of Photography. C. H. Claudy.
Photography for Young People. Tudor Jenks.
The Home Aquarium and How to Care for It. Eugene Smith.
Nature Study and Life. C. F. Hodge.
Animal Secrets Told; A Book of Whys. H. C. Brearley.
The Squirrel and Other Fur Bearers. John Burroughs.
American Animal Life. P. G. Hamerton.
Wood Folk at School. W. J. Long.
Wild Animals Every Child Should Know. Julia E. Rogers.
A Watcher in the Woods. Dallas Lore Sharp.
American Animals. Witmer Stone and W. E. Cram.
Pet Book. Anna Botsford Comstock.
Life and Her Children. Arabella Burton Buckley.
Wild Life in Woods and Field. Arabella Burton Buckley.
Bird Neighbors. Mrs. Nellie B. Doubleday.
Sharp Eyes. W. H. Gibson.
Roof and Meadow. Dallas Lore Sharp.
Birds and Bees. John Burroughs.
Nature's Garden. Mrs. Nellie B. Doubleday.
Familiar Trees and Their Leaves. Ferdinand Schuyler Matthews.
Story of the Fishes. James Newton Baskett.
Extinct Animals. Edwin Ray Lankester.
The Book of Forestry. Frederick Franklin Moon.
Animal Life in Field and Garden. Jean Henri Fabre.
Field, Forest and Farm. Jean Henri Fabre.
Insect Adventure. Jean Henri Fabre.
Woodland Tales. Ernest Thompson Seton.
Trails to Woods and Water. Clarence Hawkes.

HIGH SCHOOL AND AFTER

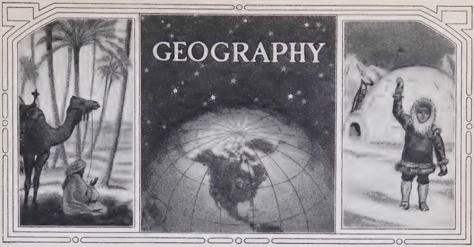
Blossom Hosts and Insect Guests. W. H. Gibson.
According to Season. Mrs. William Starr Dana.
Guide to Wild Flowers East of the Rockies. C. A Reed.
What Mr. Darwin Saw in His Voyage Around the World. Charles Darwin.
American Natural History. W. T. Hornaday.
Life History of American Insects. C. N. Weed.
Two Years in the Jungle. W. T. Hornaday.
Wild Neighbors. Ernest Ingersoll.
First Lessons with Plants. L. H. Bailey.
Wild Beasts and Their Ways. Sir Samuel W. Baker.
Curious Homes and Their Tenants. J. C. Beard.
Field and Study. John Burroughs.
The Brook Book. Mary Rogers Miller (1902).
The Spell of the Rockies. Enos Abijah Mills.
Adventures of a Nature Guide. Enos Abijah Mills.
Waiting in the Wilderness. Enos Abijah Mills.
Natural History of the Farm. James George Needham.
Music of the Wild. Mrs. Gene Stratton Porter.
Beyond the Pasture Bars. Dallas Lore Sharp.
The Lay of the Land. Dallas Lore Sharp.
Walden or Life in the Woods. Henry D. Thoreau.
The Maine Woods. Henry D. Thoreau.
How Spring Came in New England. Charles Dudley Warner.
Nature for Its Own Sake. John C. Van Dyke.
Studies in Bird Migration. William E. Clarke.
The Bird Book. Chester A. Reed.
Bird Houses. Albert F. Siepert.
Useful Birds and Their Protection. Edward Howe Forbush.
Wild Bird Guests. Ernest Harold Baynes.
My Summer in a Garden. Charles Dudley Warner.
An Island Garden. Mrs. Celia Thaxter.
Old Fashioned Gardening. Grace Tabor.
Italian Villas and Their Gardens. Mrs. Edith N. Wharton.
Reading the Weather. Thomas Morris Longstreth.
With the Trees. Maud Going.
The Secret of the Big Trees. Ellsworth Huntington.
Getting Acquainted with the Trees. John Horace MacFarland.
Life of the Bee. Maurice Maeterlinck.
Wasps—Social and Solitary. George William Peckham and Mrs. Elizabeth Peckham.
Ant Communities and How They are Governed. Henry Christopher McCook.
Ways of the Six-footed. Mrs. Anna Botsford Comstock.
Animals of the Past. Frederick Augustus Lucas.
The Life of a Fossil Hunter. Carl Hazelius Sternberg.
Shell Book. Julia Ellen Rogers.
Story of the Forest. John Gordon Doerance.

Guide to the Trees. Alice Lounsberry.
Photography Indoors and Out. Alexander Black.
The Insect Book. L. O. Howard.
Our Native Trees and How to Identify Them. Harriet L. Keeler.
Birds Through an Opera Glass. Florence A. Merriam.
Outdoor Studies. James J. Needham.
What Bird is That? F. M. Chapman.
Manual for the Study of Insects. J. H. and Anna B. Comstock.
Our Insect Friends and Foes; How to Collect, Preserve, and Study Them. B. S. Cragin.
Bird Homes. A. Radclyffe Dugmore.
Butterfly Book. W. J. Holland.
Moth Book. W. J. Holland.

Interest-Questions in Nature Study

"It has a beak like a duck, hair like a cat, and a tail like a beaver. It has four legs and web feet. It lives both on land and in the water, lays eggs and hatches them like a bird, but feeds its young with milk from the breast." What is it? 1046.
What fish are hatched out in a pouch in the body of the male parent? 3165.
Why have certain plants developed the power of catching and eating insects? 2829.
Why have some plants developed poisonous properties? 2852.
What animal spends nearly its whole life hanging upside down? 3252.
How are certain animals able to live all winter without food? 1646.
How many kinds of poisonous snakes are found in the United States? 3259.
How do water spiders get air into their nests at the bottom of ponds? 3326.
Does the flying squirrel really fly? 3334.
What large animal has no voice? 1464.
What bird takes her little ones riding on her back? 1515. What animal? 1130.
What happens to insects in the winter time? 1787.
Why do plants grown in the dark remain white? 2828.
Why do most of the four-footed animals walk on their toes? 1682.
What is the smallest mammal found in America? 2279.
Why have dachshunds such short crooked legs? 1023 (picture).
Why do swallows, unlike most other birds, travel by day when migrating? 3398.
Why do leaves change color in the fall? 1982.
Can a lion climb trees? 2024.
What reptile runs on its hind feet like a man? 2036.
Why do birds migrate in the winter? 401.
Why are most plants green? 2823.
Does a plant get most of its food from the soil or from the air? 3063.
Where do earthworms spend the winter? 1067.
What creatures construct "balloons" with which they make long journeys? 3324.
Why are birds' eggs variously colored? 407.
What animals that might have seen the Pilgrims land on Plymouth Rock are still living? 126.
What living animal may have seen Napoleon? 3563 (picture).
Why do many water plants have long slender leaves? 3700.
Why do you see so many earthworms after a rain? 1067.
What do crawfish do when they outgrow their shells? 916.
Do all insects have the same number of legs? 1787.
What animal of the United States carries its young in a pouch, as the kangaroo does? 2585.
What use is the camel's hump? 590.
Can any animals grow new body parts if they are mutilated? 917, 2036.
What familiar tree bears leaves of three different shapes? 3129.
How can you tell poison ivy from the Virginia creeper? 3651.
How does the crawfish care for its young? 917.
How long can a camel go without water? 590.
What is the largest of all birds? 2603.
What does a bird's beak tell you about its habits? 410.
What once common North American bird has been entirely extinct since 1914? 2803.
Why are most male birds more highly colored than the females? 411.
What birds build community nests? 3710.
Are whales fish? 3723.
Are there any birds that do not brood their eggs? 1090.
Which way does an elephant's hind leg bend at the knee—forward or backward? 1126.
What insects sometimes travel in such clouds that they darken the sky? 1504.
How is it that tulips and crocuses are able to get such a start over most other plants in the spring? 532.
Can cats see in total darkness? 657.
Does an elephant use its trunk in fighting? 1127.
Do male birds ever brood eggs? 1145 (picture).
What is the tallest tree in the world? 1186.
How can you tell the age of a colt by its teeth? 1683-4.
Do any coniferous trees shed their leaves in winter? 1208.
Are sponges plants or animals? 3328.
What four-footed animals lay eggs like birds? 266.
What is the only class of animals that grows hair? 1559.
What insect fights with "poison gas"? 368, 370 (picture).
What is the largest land animal that ever lived? 134. The largest sea animal? 3726.
What is the largest creature that has ever flown? 134, 136.
How do insects breathe? 1787, 660-1.
Why are kangaroos found only in Australasia? 1908.
Why might algae be called the "Adams" of the plant world? 92.
What are the "Adams" of the animal world? 118.
How can you tell a plant from an animal? 127, 394.
How can you tell butterflies from moths? 546.
What gives butterfly wings their beautiful coloring? 546.
Was there ever a bird with teeth? 138, 401 (picture).
What are the "ants' cows"? 154.
Why are a bird's bones hollow? 400.
Why should an aquarium contain plants as well as fish? 162.
What insects keep slaves? 142.
How can you tell a fir from a pine? 1248.
Can fishes hear? 1274.
Why does the "doodle-bug" dig holes in the sand? 152.
Do fishes ever change color? 1274-5.
Can any fish travel on land and climb trees? 1273, 1277.
What is the largest of fish? 1276.
What fish build nests? 3357.
What purpose is served by the color and fragrance of flowers? 1304.
How can bats "see" with their eyes closed? 345.
Are bats birds? 345.
What makes it possible for a fly to walk on the ceiling? 1312.
Why do beavers build dams? 356.
Are there any reptiles with legs and feet? 2035.
What birds lay their eggs in other birds' nests? 939.
What insect lives 17 years underground and 5 weeks above ground? 764.
Why do sycamores shed their bark? 3424.
Why do whales "blow"? 3724.
What birds get most of their food by robbing other birds? 1372.
What animal absorbs its tail as it grows? 1373.
How does a cicada "sing"? 764. A grasshopper? 1504. A cricket? 921.
What group of plants lives entirely on food manufactured by other plants and animals? 1382.
Why does the holly have thorny leaves near the ground and smooth leaves higher up? 2826 (picture).
Do both male and female mosquitoes bite? 2336.
What advantage have spiral roots over straight roots? 1306.
Can other birds than parrots be taught to speak? 927, 928.
Why does the giraffe have such long legs and neck? 1463.
What plant depends on a moth for its survival? 3835.
What bird mews like a cat? 660.
Which is the largest of all bird families? 1241.
What is the use of the firefly's light? 1263.
How do ants communicate with one another? 139.
What plant is sensitive to noise? 2829.
Why are nearly all fishes bluish on the back? 2923.
What animal "has been responsible for more untimely deaths among human beings than all the wars in history"? 2977.
What animal has a bird friend that acts as sentinel for it? 3006.
What worm is one of man's greatest enemies? 1679.
What bird sings while on its nest? 1543.
Why do ptarmigans grow feathers on their feet in winter? 1544.
Was there ever such a creature as a flying reptile? 134.
Are there any poisonous mammals? 1046.
Why are coconut palms found in so many parts of the world? 818.
What animal is said to "sweat blood" and why? 1651.
Do any of the lower animals have thumbs? 153.
How do snakes hear? 3261.
How long does it take birds to build their nests? 406.
Why do most migrating birds travel at night only? 2231.
What bird travels almost from one end of the earth to the other twice every year? 2231.
What fish kills its prey by "electrocuting" it? 3517.
How much moisture may be evaporated from a tree in one day? 3532.
Why do some plants "go into partnership"? 1994.

GEOGRAPHY



IF YOU could from memory make an accurate map of every country in the world, placing every mountain, every river, every gulf, every island, every boundary, every city in its exact and proper place, you might still know very little about Geography. This does not mean that maps and map-making are unimportant. On the contrary, it would be almost impossible to study Geography without them. But it does mean that they are nothing more than the *tools* we use in putting together and arranging our really vital knowledge.

You will miss the whole point and fascination of Geography unless you learn to see a map as you see the frame of a picture, which your imagination fills with visions of bold scenery, flowing rivers, cloud-capped mountains, fertile plains, great green forests, and wind-swept deserts. You must learn to hear in your imagination the roar of the surf on distant shores, to feel the bite of the polar cold, and the oppressive heat of the tropics. But, above all, you should see in your mind's eye the millions of people that inhabit the globe, watch them at their work and play, learn what they are all doing, and why. Why have they crowded into great swarming cities here, and why are they scattered in thin settlements there? What are those crops they grow with such care? What are they making in those workshops and in those great factories? What riches are being carried in those speeding railway cars? And those countless ships plowing to and fro over the oceans, where are they bound, and what do they bear beneath their tossing decks? Those are the questions you should ask yourself, and the pictures you should see as you glance at a map.

Geography, as we treat of it here, is the study of the Earth *as the home of man.* Viewed in this light, it becomes a broad and interesting subject. It deals with such things as the races of mankind, their character, and their customs; the influence of climate upon crops and industries; the kinds of plants and animals that thrive in various regions; the ties of trade that bind nations and peoples together; the causes of wealth and poverty in different parts of the world—in fact, with the whole *present* structure of civilization. In so far as the past physical history of the world helps us to understand the present, Geography enters the special field of Geology. And in so far as the past customs of peoples have influenced their present manners, it enters the field of History proper. Political Science, Economics, and every other branch of the "social sciences" are of prime importance to a complete understanding of geographic problems. It is with this idea of the broad interrelations of these topics that this Outline is made. Read, first of all, the article on Geography, page 1413, then follow the detailed Outline.

Physical Geography

THE EARTH AS A WHOLE AND ITS RELATION TO THE SUN

I. THE EARTH: 1058.

- **A. Its Form and Size: 1063–64.**
  - **a. Gravitation: 1506.**
  - **b. Magnetism: 853, 1064.**
- **B. Motions of the Earth:**
  - **a. Rotation on Its Axis: 1063.**
    - **1.** Poles are points marking ends of Earth's Axis.
    - **2.** Equator is line about Earth's middle, equally distant from Poles.

- **b. Revolution Around the Sun: 1063, 2816.**
  - **1.** The Earth's Orbit: 1063.
  - **2.** Axis not perpendicular to plane of Orbit: 1063.
    - —This Inclination of the Axis amounts to 23½ degrees from the perpendicular.

C. Results of Earth's Motions:

- **a. Rotation on Axis causes Day and Night: 969, 1063.**
- **b. Revolution around Sun, coupled with Inclined Axis, causes changing Seasons: 1063.** Also causes changes in length of Day and Night.
  - **1.** Equinox and Solstice: 1173, 1063.

II. ZONES OF THE EARTH:

—These Zones, like the Seasons, are the result of the Inclined Axis of the Earth. Because of this "slant," the angle at which the Sun's rays strike any point on the Earth's surface varies as the Earth revolves around its orbit. Bear in mind that it is this angle of the Sun's rays which determines the amount of heat that will be absorbed in any region. The more directly the rays strike the surface, the more heat will be absorbed: 794.

A. The Tropical or Torrid Zone: the region of greatest heat.

—The Tropical Zone may be defined for purposes of practical geography as that portion of the Earth, where, at some time during the year, the Sun is *directly overhead at noon*, so that the rays strike down perpendicularly: 1968–9.

a. Extent of Tropical Zone:

—Since the Earth's axis is 23½ degrees from the perpendicular, the Tropical Zone, of course, occupies a belt 23½ degrees wide on each side of the Equator. This makes the whole tropical belt 47 degrees wide, which amounts on the Earth's surface to about 3,030 miles: 1968–9.

b. Boundary Lines of Tropical Zone:

- **1.** North of Equator is Tropic of Cancer: 1968–9.
- **2.** South of Equator is Tropic of Capricorn: 1968–9.

B. Frigid Zones: regions of greatest cold:

—The Frigid Zones are those portions of the Earth surrounding the Poles, where, *at least once* in every year, the Sun does not rise above the horizon at noon, and where, *at least once* in every year, the Sun does not sink below the horizon at midnight. At the Poles, the Sun remains continuously above the horizon for six months, and then remains below the horizon for six months: 1968–9.

a. Extent of Frigid Zones:

—Just as the Tropical Zone extends 23½ degrees on each side of the Equator, so the Frigid Zones extend 23½ degrees on each side of the two Poles, or 47 degrees in all. Because the Earth is slightly flattened at the Poles (spheroidal), 47 degrees there amount to nearly 3,300 miles: 1968–9.

b. Boundary Lines of Frigid Zones:

- **1.** North Frigid Zone bounded by the Arctic Circle.
- **2.** South Frigid Zone bounded by the Antarctic Circle.

C. Temperate Zones: regions of moderate heat and cold:

—The two Temperate Zones are those portions of the Earth lying between the Tropical Zone and the Frigid Zones, where the Sun is never directly overhead and yet where it never fails to appear in the course of 24 hours.

a. Extent of Temperate Zones:

—Since there are 90 degrees between the Equator and the Poles, 23½ of which are in the Tropical Zone and 23½ in the Frigid Zones, it follows that the two Temperate Zones are each 43 degrees in width, or about 2,960 miles. They are called respectively North Temperate Zone and South Temperate Zone.

THE STORY OF THE EARTH'S MATERIALS

III. GEOLOGY: 1417; PHYSIOGRAPHY: 2787.

Note: Geology deals with the history of the Earth's crust and of the materials which compose it. Physiography deals with the characteristic relief features of the Earth's surface and with the causes which produced them. For the purposes of Physical Geography, these two sciences should be reviewed together, leaving such portions of Geology as deal with the ancient history of *life* upon the Earth to be studied in the Evolution section of the Biology Outline. Here we shall deal first with the physical composition of the Earth under three headings:—*Atmosphere* or Air, *Hydrosphere* or Water, and *Lithosphere* or Rocks and Soil. Then we shall study the changes in the Earth's surface and the agencies which bring them about.

IV. ATMOSPHERE OR AIR:

A. Nature and Functions of the Atmosphere: 50.

- **a. Chemical Composition of the Atmosphere: 50.**
- **b. Weight of Air: 52.**
- **c. Air Resistance and Air Pressure: 52.**
- **d. Height of the Atmosphere: 51–2.**

- **e. How Life Depends upon It: 50.**
- **f. How Climate Depends upon It: 50.**
  - —Effect of Lack of Atmosphere on the Moon: 2318.

B. Atmosphere and Climate: 794.

Note: Bear in mind in this section the enormous influence that climate exerts upon the Earth's surface, upon the distribution of plants and animals, upon crops, upon communications, upon customs—in fact, upon everything with which Geography deals.

- **a. Temperature: 794.**
  - **1.** Definition of Temperature: 1620.
  - **2.** Temperature the Dominant Factor in Climate: 794.
  - **3.** How the Earth Gets Heat from the Sun: 1619, 3392.
  - **4.** Effect of Altitude on Temperature: 794.
  - **5.** Effect of Bodies of Water on Temperature: 3693.
  - **6.** How Temperature is Measured with the Thermometer: 3486.
  - **7.** Temperature and Weather Maps—The Meaning of "Isotherms": 3708.
- **b. Moisture: 795.**
  - **1.** Moisture in the Atmosphere: 52.
  - **2.** Relative Humidity and what it Means: 1207.
    - —How Moisture is measured with the Hygrometer: 1717.
  - **3.** How Moisture Gets into the Atmosphere by Evaporation: 1207, 2972.
  - **4.** How the Atmosphere releases Moisture by Condensation and Precipitation: 1000, 2972.
    - —Clouds 808; Fog 1316; Dew 1000; Rainfall 2972; Hail 1559; Snow 3261; Frost 1375.
  - **5.** Effect of Rainfall on Vegetation: 2972.
  - **6.** How Rainfall is Measured: 2974, 3708–9.
- **c. Pressure of the Atmosphere: 52.**
  - **1.** Variations in Air Pressure: 333.
  - **2.** How Air Pressure is Measured with the Barometer: **333.**
  - **3.** The Meaning of "Isobars": 3708.
- **d. Movements of the Atmosphere—Winds: 3750.**
  - **1.** Causes of Winds: 3750.
  - **2.** Effect of Winds on Climate: 795.
  - **3.** Relations of Winds and Rainfall: 2972.
  - **4.** Various Kinds of Winds and Wind Zones:
    - —Trade Winds 3750; Doldrum Belt 3750; Westerlies 3750; Monsoons 3751, 1746–7, 2765, Chinook 82, 512; Sirocco 3751.
- **e. Storms: 3366.**
  - **1.** Cyclones, Hurricanes, and Typhoons: 3366, 944.
  - **2.** Tornadoes and Waterspouts: 3366, 3700.
  - **3.** Thundershowers: 3366, 2972.
    - —Lightning: 2006.
- **f. The Weather Bureau and Its Work: 3708.**

Note: The climate of any part of the Earth depends, as you can now see, upon two factors—the unchanging factor of Season and Zone and the variable factor of the Atmosphere and its phenomena. In the study of the individual continent and country, you will find practical examples of this principle.

V. HYDROSPHERE OR WATER:

A. Nature and Functions of the Waters of the Earth: 3693.

- **a. The Importance of Water to All Life: 394, 2824.**
- **b. Density and Weight of Water: 1403, 3715.**
- **c. Chemistry of Water: 714, 716.**
- **d. Behavior of Water when Freezing or Melting: 1618, 1720.**

B. Water Formations:

- **a. Oceans: 2553.**
- **b. Lakes: 1957.**
- **c. Rivers: 3022.**
- **d. Springs: 3331.**
- **e. Water Formations beneath the Surface: 221, 3331.**

Note: All of the water formations except Oceans will be studied in **Section VII.** The intimate association between Lakes, Rivers, etc., and the Land formations makes it advisable to consider them in that connection, rather than to give them separate treatment here.

C. Oceans: 2553.

- **a. The Ocean Beds:**
  - **1.** Origin of the Ocean Beds: 2788.
  - **2.** Character of the Ocean Beds: 2792.

  - **3.** Ocean Beds Compared to Continent Masses: 2553.
  - **4.** Geologic Changes in Sea Level: 1420.
  - **5.** Ocean Depths: 2553, 51, 2617.
    —Exploring Ocean Depths: 2556, 1014, 2778.
- **b. Movements of Ocean Waters:**
  - **1.** Nature of Waves: 3705.
  - **2.** Ocean Currents and Their Work: 2558, 1549, 77.
  - **3.** Tides: 3496.
- **c. Effect of Oceans on Climate: 794, 2558-9.**
- **d. Life in the Oceans: 396, 2555, 2556, 2557.**
  - **1.** Corals and Their Work: 884.
  - **2.** Phosphorescence: 2776.

VI. LITHOSPHERE OR ROCK AND SOIL:

- **A. Rock Formations of the Earth: 1417.**
  - **a. Igneous or Unstratified Rock**—comprising all the rocks which have solidified from an intensely heated molten state: 1417.
    —Lava 1971; Granite 1497; Basalt (Fingal's Cave) 3148, (Giant's Causeway) 1809; Quartz 2945; Feldspar 1230; Obsidian 1972; Porphyry 1972; Pumice 1972.
  - **b. Sedimentary or Stratified Rock**—comprising those rocks produced by deposits of distintegrated matter from the older rock forms, by deposits of animal or plant remains, or by chemical precipitates: 1417.
    - **1.** Rock Sediments: Sandstone 3123; Clay 783, 3248; Mudstone 3248; Shale 3248.
    - **2.** Animal and Plant Sediments: Limestone 2010; Dolomite 2010; Chalk 685; Coal 811; Peat 2704; Asphalt 234.
    - **3.** Chemical Sediments: Gypsum 1554; Salt 3115.
  - **c. Metamorphic Rock**—comprising ancient sedimentary forms which have undergone profound chemical and structural changes: 1417.
    —Marble 2144; Flint 1292; Slate 3248; Mica 2219.
- **B. The Formation of Soil: 3272.**

Note: We have seen that the sedimentary rocks were formed for the most part from the disintegrated igneous rocks and from the remains of animals and plants. The same forces of weather and decay which produced those ancient sediments are busy producing the soil which covers the Earth today. And today's soil is on the same road as that silt of bygone ages. The rains wash it away to the rivers and the rivers carry it to the sea, where it is deposited in vast layers one upon the other. In the course of time it will turn into rock again. Thus the rocks and the life of today are the soil of tomorrow, and the soil of today is the rock of tomorrow—if you count your todays and tomorrows as millions of years long. In the picture on page 1421 you will find explained a special form of this everlasting cycle of change.

- **a. Chief Forces in Soil Production:**
  - **1.** Sun and Rain: 3273.
  - **2.** Streams and Ocean Waves: 3273.
  - **3.** Winds: 3750, 3273.
  - **4.** Frost: 3273.
  - **5.** Glaciers: 1466, 3273, 2516.
  - **6.** Decay and the Work of Bacteria: 3273, 302.
- **b. Principal Kinds of Soil:**
  - **1.** Residual Soils—formed by the breaking down of the underlying rocks.
    —Sand 3121; Clay soils from Shale 3273; Limestone soils 2010.
  - **2.** Transported Soils—consisting chiefly of "alluvial" soils transported and deposited by rivers, "eolian" soils transported by the wind, "drift" soils transported by glaciers, and "ash" soils composed of ashes ejected from volcanoes.
    —Humus and Loam 3273; Loess 3273, 3750; Drift 2516, 1466, 1721.

CHIEF FEATURES OF THE EARTH'S SURFACE AND THEIR ORIGIN

VII. PHYSIOGRAPHY OF THE EARTH:

- **A. Continents:**
  - **a. Origin of Continents: 2788, 2516.**
    - **1.** How Fossils prove that Continents came out of the Sea: 1334, 2516, 3421.
    - **2.** Ancient History of Continents:
      —Ice Age: 1720, 1466, 2516.
      —The North Sea, as an example of how parts of ancient continents have been submerged: 2528.
  - **b. The Continental Shelf: 2788, 2558.**
  - **c. Irregularities of Continental Outlines and Their Origin:**
    —Peninsulas, Capes, Gulfs, and Bays: 2788.

- **d. Comparative Size of the Continents: 2791.**
- **e. "Continental" as Opposed to "Oceanic" Climate: 794–5.**

B. Mountains: 2357.

- **a. Origin of Mountains: 2358, 2790.**
  - —"Old" and "Young" Mountains: 2789.
- **b. Effect of Mountains on Climate: 795, 3588, 512, 2790.**
  - —Effect upon Rainfall: 2973, 1747.
- **c. Effect of Mountains on Human Life: 2358, 2790.**
  - —How Mountains Play a Part in History: 2515, 3581, 1193, 3302.
- **d. Mountains Chief Sources of Minerals: 2248.**

C. Rivers: 3022.

- **a. Origin of Rivers: 3022-3.**
  - —Springs: 3331.
- **b. The Work of Rivers: 3022.**
  - **1.** Cutting Valleys and Transporting Soil: 2791, 3615.
  - **2.** Forming Alluvial Plains: 2791, 2266, 3273.
  - **3.** Deltas and How They are Made: 2791, 3023.
- **c. Effect of Rivers on Human Life: 3022.**
  - **1.** Value of Rivers for Transportation: 3524.
  - **2.** Their Value for Irrigation: 1828–30.
  - **3.** Their Value for Water Power: 3694–5.

D. Valleys: 3615.

- **a. Origin of Valleys: 2791, 3615.**
  - —Canyons: 639.
- **b. "Old" and "Young" Valleys: 2789, 2791, 3615.**

Note: Since Valleys are, of course, always associated with Mountains or Rivers, the preceding sections will have brought out already the chief points for study, which need not be repeated here.

E. Lakes: 1957.

- **a. Origin of Lakes: 1957, 1721.**
  - —Formed in Closed Land Basins: 2791.
- **b. Influence of Lakes on Human Life:**
  - **1.** Ancient Lake-Dwellers: 1957, 771–2, 773.
  - **2.** Influence of Lakes on Climate: 1510.
  - **3.** Lake Transportation (Great Lakes): 1510.
- **c. Salt Lakes: 1515, 2644.**

F. Plains and Plateaus: 2788, 2790.

- **a. Origin of Plains and Plateaus: 2790.**
- **b. Influence on Human Life:**
  - —Concentration of Population on Plains: 2790.
- **c. Various Kinds of Plains: 2790.**
  - —Tundras 226, 1191, 3085; Steppes 230, 1702, 3086; Savannas 34; Pampas 190, 191, 3285.
- **d. Laurentian Plateau as an Illustration of Plateau Features: 1970.**

G. Deserts:

- **a. The Sahara as an Example of the Origin of Deserts: 3104.**
- **b. Characteristics of Other Great Deserts: 228, 3555, 262.**

H. Islands:

- **a. Origin of Islands: 2788.**
  - **1.** Volcanic Islands: 3658, 2621.
  - **2.** Coral Islands (Atolls): 886, 2621.
- **b. The World's Largest Islands: 468.**

I. Other Features of the Earth's Surface:

- **a. Volcanoes—Their Origin and Behavior: 3657.**
- **b. Earthquakes: 1064.**
- **c. Geysers: 1454.**
- **d. Caves: 664.**

HOW THE EARTH'S SURFACE IS MEASURED OFF AND PICTURED

VIII. THE POINTS OF THE COMPASS: 854.

Note: Bear in mind that directions upon the Earth are all related to the Earth's axis, which establishes the North and South Poles. East at any point on the Earth's surface is the direction in which that point is moving around the Earth's axis, and West is simply the opposite direction.

A. Difference between Geographic and Magnetic Poles: 854, 1064.

B. The Compass as an Aid in Determining Directions: 853.

IX. LATITUDE AND LONGITUDE: 1968.

- **A. Parallels of Latitude and what They Mean: 1968.**
  - —Length of a Degree of Latitude: 1968.
- **B. Meridians of Longitude and what They Mean: 1968, 2061.**
  - —Length of the Degrees of Longitudes at Various Latitudes: 2061.
- **C. How the Latitude and Longitude of a Place is Determined: 2420.**

X. MAPS AND MAP-MAKING: 2142.

- **A. Difficulties of Map-Making:**
  - **a. Globes the Only Correct Representations of Earth's Surface: 2142–3.**
  - **b. All Flat Maps More or Less Distorted: 2142–3.**
- **B. Map Projections: 2142.**
  - —Conic Projections and Mercator's Projection: 2142.
- **C. Geodetic Surveys, the Basis for Accurate Map-Making: 3397, 3398.**

RACES OF MANKIND

IN the study of the racial differences existing between the Earth's inhabitants, countless problems arise about their relationships and origin. The chief difficulty encountered by the ethnologists, as the students of this subject are called, is to disentangle the innumerable mixtures and shades of difference that have arisen in the course of ages, and find the basic "types" from which all have sprung. With such difficulties, however, the student of Geography is not primarily concerned. For him it is not so important to know the relationships and origin of peoples as it is to have a convenient method for grouping them according to their present-day customs, their degree of civilization, and their geographical distribution. The grouping followed in this Outline brings out some of the more generally accepted racial affinities, but in the main its purpose is to emphasize the geographical and cultural side of this great subject.

I. ANTHROPOLOGY—MAN'S PLACE IN NATURE: 149.

II. RACES OF MANKIND: 2956.

- **A. The Many Methods of Classification:**
  - **a. Skull Measurements: 2956.**
  - **b. Differences in Hair: 1560.**
  - **c. Differences in Language: 2956, 2771.**
  - **d. Differences in Color of Skin: 2956, 3246.**
  - **e. Geographical Distribution: 2956.**

Note: The last two are generally used as the basis for classification in the study of Geography.

- **B. The Races Based on Color and Geographical Distribution: 2956.**
  - **a. The Caucasian, European, or White Race.**
  - **b. The Ethiopian, African, or Black Race.**
  - **c. The Mongolian, Asiatic, or Yellow Race.**
  - **d. The Amerind, American, or Red Race.**
  - **e. The Malay and Polynesian, or Brown Race.**
- **C. General Characteristics of the Races.**
  - **a. The Supremacy of the White Race: 2956–7.**
  - **b. The Sudan and Bantu Negroes as Types of the Black Race: 37.**
  - **c. The Chinese as Types of the Yellow Race: 740–4.**
  - **d. The North American Indian as a Type of the Red Race: 1768–72.**
  - **e. The Malays (2130), the New Guineans (2451), and the Polynesians (2620) as Types of the Brown Race.**

III. THE WHITE RACE:

Note: Certain peoples, once important in history but now no longer existing as separate groups, have been included in this list. These are indicated by Italic type. The divisions into South Mediterranean and North Mediterranean peoples have no connection with the "Mediterranean Race" described on page 2956 as distinct from the "Nordic" and "Alpine" races of Europe. Those distinctions are definitely ethnological, whereas the one we make here is purely geographic.

- **A. South Mediterranean:**
  - **a. Hamitic**—Present-day types found chiefly in North Africa:
    - —Berbers 2323; *Ancient Aegeans* 28; *Etruscans* or *Tyrrhenians* 1185; *Numidians* 3549; Tuaregs 33, 37, 3105; Copts 1094; Fellahin 1096; Kabyles, Masai, Gallas, Somalis: 37.

Note: The people known today as "Moors" are largely of Berber origin, but Arab and Negro blood is distinctly traceable among them. Historically the term is applied to the Mohammedan invaders of Spain: 2323.

  - **b. Semitic**—Present-day types found chiefly in the Arabian Peninsula, Asia Minor, and North Africa:
    - —Arabs 232; *Arameans* 3425; Bedouins 165; *Assyrians* 297; *Carthaginians* 650, 2774; *Hittites* 1669, 234; Israelites (Jews) 1889; *Phoenicians* 2774; *Samaritans, Canaanites* 1890; Syrians 3425; *Philistines* 2770.

B. North Mediterranean:

Note: The Europeans of today are the chief representatives of this great division, and therefore it is called the "North Mediterranean" branch of the white race. It includes, however, several Asiatic groups as you will see by the Outline. The term "Aryan," which is often used to describe those members of the white race which are believed to have originated in western Asia, is synonymous with "Indo-European" and can properly be used only when people are being classified according to languages: 2771, 224, 1748, 1842, 3040.

- **a. Primitive European Types:**
  —Basques 3301; Iberians 1343, 3301; Ligurians 1343.
- **b. Celts: 673–4, 1152, 1194.**
  —Bretons 514; *Britons* 1151; *Gauls* 1343, 3044; Irish 674, 1807; Manx 674; *Picts* and Scots 3147; Welsh 3664.
- **c. Italic or Latin Type: 3040, 1842.**
  —French 1343–4, 1352; Italians 1840–1; *Latins* 3040; Portuguese 2889; Rumanians (Rumans or Vlachs) 3082; *Sabines* 3040; Spanish 3298–3305.
- **d. Illyric Peoples:**
  —Albanians 79, 1528; *Illyrians* 79, 1518 (map); *Thracians* 1518 (map).
- **e. Hellenic Peoples:**
  —Greeks 1520, 1528; *Macedonians* 86, 2096; *Phrygians* 1518 (map).
- **f. Lettic Peoples:**
  —Letts 1969; Lithuanians 2030; *Baltic* or *"Old" Prussians* 3250.
- **g. Teutons: 1194, 3472.**
  —East Teutons: Danes 639, 1152; *Goths* 1491; *Northmen* or *Normans* 2525, 1195, 2513; Scandinavians 3134; *Vandals* 3303; *Burgundians* 1194.
  —West Teutons: Angles 1152; Dutch 2438; English 1150–4; *Franks* 810, 1195, 1352; Germans 1445–6; *Saxons* 1152, 3132; *Alemannians* 1194; *Lombards* or *Langobards* 2047, 1194.
- **h. Slavs: 3250, 1194, 1901–2.**
  —Bosniaks 3250, 468; Bulgarians 533; Croatians 271, 307, 1901, 3250; Czechs or Bohemians 948, 447; Montenegrins 2313; Poles 2857, 3250; Slovenians 3250, 1901; Russians 664, 3250, 3088, 3229; Serbs 3176–7, 1901; Dalmatians, Moravians, Ruthenians or Ukrainians, Slovaks, Wends: 3250.
- **i. Indo-Iranians:**
  —Armenians 213, 664; Baluchis (inhabitants of Baluchistan) 1744, 2735; Kurds 1945, 213, 2735; *Medes* 2191, 2737; Persians 2735; Gipsies 1462–3, 2735, 3558; Hindus 1651, 1748; Ceylonese or Sinhalese 685.

Note: The Afghans have an obscure origin, some authorities classing them with the Semitic peoples and some with the Indo-Iranians: 31.

- **j. Caucasic Type: 232.**
  —Circassians 664, 3558; Georgians 664.

Note: The white peoples of North and South America are, of course, not racially distinct from the peoples of Europe. They do not, therefore, find a separate place in this Outline, but will be studied under the various New World countries.

IV. THE BLACK RACE:

A. Negrito Type: 2434.

- **a. Equatorial Pigmies: 38.**
- **b. South African Branches:**
  —Bushmen, Hottentots: 37, 3280.
- **c. East Indian Groups:**
  —Negritos of Philippines 2765; Andaman Islanders 1756; Semangs and Sakais: 2130.
- **d. Australian Groups:**
  —Blackfellows 261, 266, 2119; Tasmanians 3438.

Note: The list of peoples named above present unusual difficulties to the ethnologists. The student is specially cautioned against regarding this arrangement as an implication of true racial affinity. They are grouped together because of their general resemblance to the negro type and because they present on the whole the lowest forms of civilization found in the world today.

B. True Negro Type: 2434.

- **a. Sudanese Negroes: 37, 35.**
- **b. Guinea Coast Negroes:**
  —Ashantis: 33.

C. Negroid or Bantu Type: 37, 2434, 38 (picture).
—Basutos (Natives of Basutoland) 3283; Bechuanas (Natives of Bechuanaland) 3283; Kaffirs 3280, 36; Swahilis 1068; Zulus 3280, 36.

V. THE YELLOW RACE:

A. Eastern Mongolian Type:

- **a. Southern Chinese: 742.**
- **b. Indo-Chinese: 1777, 2130.**
  —Anamese 1777; Burmese 540–1, 3015; Siamese 3227; Tonkinese 1777; Shans, Chins, Kackins: 541.

- c. **Tibetan Group: 1748.**
    - —Bhutanese (Inhabitants of Bhutan 1744, 1748); Nepalese (inhabitants of Nepal 1744); Tibetans 1748, 3496, 231.

B. Western Mongolian Type—This type is sometimes called "Ural-Altaic:" 3557.

- a. **Manchu Group: 746, 2134.**
- b. **Mongol-Tatar Group: 2285, 3440, 664.**
    - —Kalmuks 2286; Cossacks 895; Tatars 3440; *Huns* 1491, 1704; Kirghiz 230; True Mongols 2285; Turkomans 3555; Turks 3557–8.
- c. **Finnish Group:**
    - —Esthonians or Esths 1180; Finns 1248; Lapps 1962, 1702, 3403; *Avars* 1195, 1702; Magyars 271, 524, 1702; Ostiaks 1702.
- d. **Japanese-Korean Group:**
    - —Japanese 1332, 1862; Koreans 1942.

Note: The Ainos or Ainus, inhabiting the Japanese islands of Hokushu and Sakhalin, are descendants of a primitive type very difficult to classify. Some authorities connect these short hairy savages with the ancient stock of the Caucasian or white race.

VI. THE BROWN RACE:

- **A. Dravidian Group:**
    - —Gonds, Bhils, Tamils: 1748; Veddahs 685.
- **B. Malayan Type: 2130.**
    - a. **East Indian Group:**
        - —Dyaks 467; Javanese 1879; Malays 2130; Sumatrese 3391; Igorots 2765–6; Moros 2766.
    - b. **Madagascar Group:**
        - —Hovas and Malagasies 2105, 2106.
- **C. Oceanic Type:**
    - a. **Papuan or Melanesian Group: 1072, 2451.**
        - —New Guineans 2451; New Hebrideans, New Caledonians, Solomon Islanders: 2620; Fijians (in part) 1239.
    - b. **Micronesian Group:**
        - —Inhabitants of the Ladrones, Pelew, Caroline, Marshall, and Gilbert Islands: 2620.
    - c. **Polynesian Group: 2621.**
        - —Hawaiians 1605; Maoris 2499; Samoans 3120–1; Fijians (in part) 1239; Tahitians, Tongans, Marquesans, and other inhabitants of the more eastern Pacific islands: 2621.

Note: Some eminent ethnologists regard the Polynesians as descendants of an ancient Aryan or white stock which came across southeastern Asia and over the waters of the Pacific centuries ago, settling in one after the other of the islands they now inhabit.

VII. THE RED RACE: 111, 2956.

- **A. Arctic Type:**
    - —Eskimos and Aleutian Islanders or Aleuts: 1174, 78.
- **B. North American Types** (Alaska, Canada, and United States):
    - a. **Athabascan Group: 1767.**
        - —Apaches 1767, 2467; Navajos 1767, 202; and many smaller tribes in northwestern Canada.
    - b. **Algonquian Group: 1765.**
        - —Arapahoes 844, 1767; Delawares, Kickapoos, Mohicans, Narragansetts, Piankishaws, Potawatomies, and Sacs and Foxes: 1765; Blackfeet, and Ottawas: 1766; Cheyennes, Chippewas or Ojibwas: 1767; Crees 1767, 3129; Miamis 3452; Shawnees 3451–2; Grosventres, Menominees, Micmacs, and Passamaquoddies.
    - c. **Iroquoian Group: 1766.**
        - —Cayugas, Cherokees, Hurons, Iroquois, Mohawks, Oneidas, Onondagas, Senecas, and Tuscaroras: 1766.
    - d. **Muskhogean Group:**
        - —Apalachicolas, Chickasaws, Choctaws, Creeks, Natchez, Seminoles: 1766.
    - e. **Siouan Group:**
        - —Assiniboins, Crows, Dakotas, Mandans, Omahas, Osages, Sioux: 1767; Catawbas, Iowas, Poncas, and Winnebagoes.
    - f. **Shoshonean Group: 2445.**
        - —Bannocks, and Utes: 1767; Comanches 844; Hopis or Moquis 202, 1767; Shoshones 1767, 2445; Piutes, Pimas.
    - g. **Smaller Groups:**
        - —Among the lesser divisions and tribes which do not fit into any of the preceding groups are the following: Bella Coolas, Chinooks, Kutenais, Maidus, Maricopas, Mojaves, Nez Percés, Nootkas, Pawnees, Snakes, Taos, Wichitas, Washos, Yumans, Zunis, and Flatheads: 1767; Thlingits or Tlinkits 78, 1767.

Note: The so-called "Pueblo" Indians did not belong to any single tribe or group, but consisted of several independent stocks in various parts of the Southwest who were distinguished by their settled and semi-civilized life in tribal villages: 2933, 2467.

C. Mexican and Central American Types:

- **a. Nahuan Group: 288.**
  - —Aztecs 894, 2216 (picture), 288.
- **b Mayan Group:**
  - —Mayas 3834–5, 289 (picture).

Note: Central America is inhabited by an extraordinary mixture of native races, so confused by foreign blood that a definite separation into groups is almost impossible. In the northern regions of Central America, the Mayas appear to predominate.

D. South American Types:

- **a. Chibcan Group**—centering in Colombia.
- **b. Quechuan Group**—centering in Peru.
  - —Incas 1741, 2744, 3289.
- **c. Aymaran Group**—centering in Southern Peru, Bolivia, and Northern Chile: **3287** (picture).
- **d. Calchaquan Group**—centering in northern Argentina.
- **e. Araucanian Group**—distributed widely through Chile and western Argentina. This group includes most of the tribes which resisted for so long a time the Spanish invaders: **738.**
- **f. Cariban Group**—distributed over Venezuela, Guiana, and the Amazon delta. Formerly the Caribs inhabited also many of the islands in the Caribbean Sea.
  - —Caribs: 3622.
- **g. Tupi-Guarani Group**—centering in Brazil. From the point of view of language this is the most important of the South American groups. Such words as "jaguar," "tapioca" come from the Tupian tongue.
- **h. Arawakan Group**—formerly inhabiting Haiti, Porto Rico, Cuba, The Bahamas, etc., as well as their present home in the Amazon valley. They were the first people of the New World to come in contact with the European discoveries.
  - —Arawaks: 3622; Chunchos 2741 (picture), 3287 (picture).
- **i. Patagonian Group**—centering in Southern Argentina: **190, 2692.**
- **j. Fuegian Group**—distributed through Tierra del Fuego (**735-6, 3285**) and extending a short distance north of the Strait of Magellan. These Indians represent the lowest form of savagery found in the New World. They are divided into three types—the Onas, the Yahgans, and the Alakalufs.

NORTH AMERICA

AS you read this, you should have before you the big map next to page 2515. This will help to emphasize the text, point by point. First of all, we must remember that four centuries ago North America was in a state but little removed from primitive savagery. It had just been discovered by the civilized peoples of Europe, and its size and importance were not even dimly realized. Three centuries ago permanent settlements by white men had been made in only a very few places along the coasts. Two centuries ago the great interior of vast plains and rugged mountain ranges was still a region of mystery. And as late as a century ago only a very few hardy explorers had succeeded in crossing the great breadth of the continent from coast to coast.

Today we see that a swift and almost miraculous change has spread over the face of the land. North America has become the seat of a civilization which rivals Europe in culture and surpasses Europe in material progress. What great influences have been at work to bring about so rapid and magnificent a development? Why has North America so far surpassed South America in this respect, although the European penetration of South America began earlier and progressed far more rapidly at first? These are the questions which the student of North American geography should continually keep before him.

Look at your map. You will notice that the Arctic Circle cuts across the continent far to the north and that you do not meet the Tropic of Cancer until you reach Central Mexico. What does this mean? It means that the great bulk of North America lies in the *temperate* zone, that the climate of this vast sweep of land is moderate, neither very hot nor very cold—such a climate as is best suited to the greatest variety of human enterprises. South America, as you can see by a glance at the map next to page 3289, has its largest area in the *tropical* zone.

Next, we must bear in mind that North America was, at the advent of the white man, very thinly inhabited. Bringing with them the advantages of European civilization, the early settlers were not confronted with the problem of a dense and highly organized population to which they had to adjust themselves. The Indians, bold and intelligent though they were by nature, were wanderers, comparatively few in number, and divided into countless warring tribes. Their resistance soon crumpled before the white man. Thus the Europeans were free to build this new branch of their civilization upon entirely new ground, hampered neither by prolonged native resistance nor by the obstacle of ancient customs and traditions which retarded the development of political and industrial innovations in their home lands.

In contrasting the progress of North and South America it is important to note another great distinction. South America was chiefly colonized by Spaniards and Portuguese, who did not regard the New World as a land to be settled and developed, but who looked upon it merely as a treasure house of gold and silver and other precious products, which was to be exploited for the sole benefit of the governments at home. Among the English, Dutch, and French settlers of North America, however, there were many who sought the New World as a *permanent home,* who strove to develop agriculture, fisheries, and other industries less alluring than the search for gold, but carrying with them a sounder promise for the future.

These are just a few of the most important influences which affected the development of North America. Many others will suggest themselves in the course of this Outline. Watch for them!

LAND FORMATIONS OF NORTH AMERICA

I. GEOLOGICAL HISTORY

A. Growth of the Continent: 2516.

a. Land Rises from the Ocean: 2516.

b. The Great Coal Beds: 812, 3590.

1. Origin of the Coal Beds: 2516, 811, 158.

2. Formation of Different Kinds of Coal:
—Lignite, Bituminous, and Anthracite: 812.

c. Origin of Iron and Other Mineral Deposits: 2516.

d. The Great Petroleum Fields and Their Origin: 2750–1, 2754–5, 2211.

B. Formation of Mountain Ranges and Plateaus:
—See map showing Heights and Depths, facing page 2514.

a. The Laurentian Plateau—extending from northern Labrador to western tip of Lake Superior, and north to Hudson Bay plain: **1970, 2516.**

1. One of the Oldest Land Formations on Earth: 1970.

2. Important Mineral Deposits: 1970.

b. The Appalachian Mountains—extending from Gulf of St. Lawrence parallel with Atlantic Coast almost to the Gulf of Mexico: **158, 2516, 3580.**

Note: The Appalachian chain of mountains includes the following: the highlands of eastern Quebec and of New Brunswick; the highlands of Maine (2125); the **White Mountains** of New Hampshire (2453); the **Green Mountains** of Vermont (3632); the **Berkshire Hills** (2168); the highlands of the lower Hudson River (1692); the **Allegheny Mountains** of Pennsylvania and West Virginia (2160, 3720); the **Blue Ridge** (70, 2160, 3647), consisting of the main range in Virginia, the **Black Mountains** of North Carolina (158), and other spurs into South Carolina and Georgia; the **Cumberland Mountains** of Virginia, Kentucky, and Tennessee (1916, 3466); the **Great Smoky Mountains** of Tennessee and North Carolina (3465); the **Lookout Mountain Ridge** of Tennessee and Alabama (70); and many other divisions variously named. The **Catskill Mountains** of New York (2482) are usually regarded merely as the northern extension of the Allegheny Plateau (*see* below) which has been cut up into hills (2790). The **Adirondack Mountains** (25), on the other hand, are considered as an isolated spur of the Laurentian highlands, cut off from the main Laurentian Plateau by the St. Lawrence River.

1. Evidences of the Great Age of the Appalachians: 2516, 158.

2. The Piedmont Plateau on the Eastern Slope: 3290, 3291 (map), 2160, 2518 (map).

3. The Allegheny Plateau on the Western Slope: 2718.

c. The Ozark Plateau: 3581.
—The highlands which make up the Ozark Plateau are regarded as geologically related to the Appalachians. The name **Ozark Mountains** (2616, 2269, 207) is given to the low forested hills forming the northern division of the plateau and extending from southern Illinois, across the southern half of Missouri, into northern Arkansas and northeastern Oklahoma. The **Ouachita Mountains** (208 map, 2574 map, 2576) form the southern tip of the plateau, extending from western Arkansas into eastern Oklahoma.

d. The Cordillera Ranges: 2515, 3035, 3580.

Note: The Cordilleras include the **Rocky Mountains** (3035), the **Sierra Nevada** (3231), the **Cascade Range** (3686–7, 2594), the **Alaskan ranges** (75, 76), the **Eastern** and **Western Sierra Madre** (2209, 3580), and several lesser ranges of the west.

1. Much Younger Mountains than the Appalachians: 2516, 3036.
—See the picture "The Aged Appalachians and the Young Rockies," page 158.

2. Cordilleras Still Growing: 2517.
—This is the cause of Earthquakes: 2517.

3. Contain Boundless Mineral Wealth: 3035–6, 2210–11, 74.

e. The Great Basin—comprising the extensive area between the Rocky Mountains and the Sierra Nevada Range and including the region formerly called the "Great American Desert": **3580, 1064.**

f. The Great Mexican Plateau—consisting of the vast stretch of table-land between the two Sierra Madre ranges: **2209, 2515.**

g. Mountains Due to Volcanic Action: 2515, 3658.
—Mount Rainier 3658, Mount Shasta 3231, Lassen Peak 3231, Popocatepetl and Orizaba 2209, Mount Katmai 77, and numerous others.

C. Plains:

a. The Great Central Plain: 2515, 3581.

—In the broad sense used here, the Great Central Plain stretches from the Arctic Ocean to the Gulf of Mexico, including the whole region drained by the Mississippi and its tributaries, as well as the Great Lakes Plain, the Canadian lake region, and the Mackenzie River Basin. In the United States this region is usually divided into the "Great Plains" and the "Central Plains": 3581.

1. Fossils prove this was once an ocean bed: 2516.

2. How the land rose and the rivers filled up the shallows with sediment: 2516, 2266, 2791.
—This sediment makes the Mississippi Valley one of the most fertile regions in the world today. 2265.

b. Northern Plain—between the Laurentian Plateau and Hudson Bay: **1690.**

c. Coastal Plains:

1. The Atlantic Coastal Plain: 2790.
—Extending from Cape Cod to Florida.

2. The Gulf Coastal Plain: 3581, 2209.
—Extending around the whole Gulf of Mexico from Florida to Yucatan.

D. The Ice Age in North America: 1720, 2516, 795.

a. Extent of the Ice Sheet: 1720, 1466.
—Remnants of the Ice Sheet in Greenland: 2516, 1540.

b. Effects of the Moving Glaciers: 1466, 1721, 2516.

1. Moraines 1466; Drifts 1721.

2. How the Ice Sheet helped to form the great North American chain of lakes, including the Great Lakes: 1957, 1721, 2516.

3. How it blocked and diverted river courses: 1721, 2571, 2253 (picture).
—The water falls and rapids which provide such a vast amount of water power in the United States and Canada originated in this way: 1721, 2516.

4. Character of "drift" soil.
—The bowlders and pebbles of New England: 2516.
—The highly fertile soil of the Great Lakes region: 2516, 1757, 2253, 2571.

E. Origin of North America's Present Coast Line: 2517.

a. Up and Down Movements of the Land: 2517.

b. Results of the Sinking of the Northern Coast:
—Deep bays and inlets providing fine harbors in the northeast and northwest: 2517, 2790, 510.

c. Results of the Rising of the Southern Coast:
—Shallow coast with few natural harbors in the southeast, south, and southwest: 2517.

WATER FORMATIONS OF NORTH AMERICA

II. RIVERS AND LAKES EAST OF THE CONTINENTAL DIVIDE:

—The Continental Divide is the line winding through the Cordillera ranges which separates the headwaters of rivers flowing into the Atlantic and Gulf from the headwaters of rivers which flow into the Pacific:

A. The St. Lawrence River System and the Great Lakes: 3107, 1510.
—The course of this water system lies between the main division of the Laurentian Plateau and the Appalachians.

a. Chief Tributaries of the St. Lawrence:
—Saguenay 1970; Ottawa 2604; St. Maurice 2947 (picture).

b. The Great Lakes:
—Superior 3397; Michigan 2227; Huron 1704; Erie 1174; Ontario 2583.

B. The Rivers of the Atlantic Coastal Plain:

a. Chief Rivers Rising in the Northern Division of the Appalachians:
—St. John 3107; Penobscot and Kennebec 2126; Merrimack 2454; Connecticut 2454, 864.

b. The Hudson River: 1692.
—The Hudson rises in a southern spur of the Laurentian Plateau (Adirondacks) and cuts through to the sea, dividing the Northern Division of the Appalachians from the Southern Division.

c. Chief Rivers Rising in the Southern Division of the Appalachians:
—Delaware 989; Susquehanna 158; Potomac 2902; James 3648; Roanoke 3648; Neuse 2518 (map); Cape Fear 2518; Peedee and Santee 3291 (map); Savannah 1432; Altamaha 1432 (map).

C. Rivers of the Gulf Coastal Plain (excluding the Mississippi and Rio Grande River Systems): **1548.**

a. Flowing into the Gulf East of the Mississippi:
—Suwanee and Apalachicola 1298 (map); Mobile (Alabama and Tombigbee) 72; Pascagoula and Pearl 2262 (map).

b. Between the Mississippi and the Rio Grande: 3476.
—Sabine, Trinity, Brazos, Colorado (not to be confused with the great Colorado River of the west). Guadalupe, San Antonio, and Nueces 3476.

c. South of the Rio Grande:
—Moctezuma and Usumacinta: 2209 (map).

D. The Mississippi-Missouri River System: 2515, 2265, 2273, 3582.

a. The Mississippi: 2265–8.

—Rising from Lake Itasca in the Great Lakes Plain, just west of the extension of the Laurentian Plateau which curves around the tip of Lake Superior.

b. Tributaries of the Mississippi from the East:

1. Rivers north of the Ohio:

—Rising from the Laurentian Plateau and the Great Lakes Plain: St. Croix 3770; Chippewa 2266; Wisconsin 3768; Illinois 1730; Rock and Kaskaskia 1731 (map).

2. The Ohio River and Its Tributaries: 2572–3.

—Northern tributaries of the Ohio from the Great Lakes Plain: Wabash 1757; Miami, Scioto, and Muskingum 2573.

—Southern and Eastern tributaries of the Ohio flowing from the Appalachians: Tennessee and Cumberland 3466; Green, Kentucky, Licking, and Big Sandy 1917 (map); Kanawha 3720; Monongahela and Allegheny 2573.

3. Rivers south of the Ohio:

—With the exception of the Yazoo (2261–2), the tributaries of the Mississippi south of the Ohio are unimportant.

c. Tributaries of the Mississippi from the West:

1. Rivers of the Missouri rising in the Great Central Plain: Minnesota 2254 (map); Iowa and Des Moines: 1804 (map).

2. The Missouri River and Its Tributaries: 2273–4.

—From the Great Central Plains to the north and east, the Missouri has no tributaries of much importance, the James (3294) being the chief.

—Tributaries from the Great Plains and Rocky Mountains to the west and south: Kansas 1910 (map); Platte 2430; Niobrara 2429; White 3296; Cheyenne 3296 (map); Little Missouri 2524 (map); Yellowstone 3830.

3. Rivers south of the Missouri:

—Arkansas 208 (map), with its two tributaries, the Cimarron 2574 (map), and the Canadian 2574 (map); Red 2576.

Note: In connection with the effect of the Ice Age upon the course of rivers, it is interesting to know that the southern limit of the great ice-cap at that period coincided almost exactly with the great arc formed across the continent by the present course of the Ohio and Missouri rivers.

E. The Rio Grande System: 3582, 3022.

—The Rio Grande and its chief tributary, the Pecos (3476), rise near the southern tip of the Rocky Mountain Range. The only important tributary from the south is the Conchos (2209 map), whose waters flow from the Western Sierra Madre.

III. RIVERS WEST OF THE CONTINENTAL DIVIDE:

A. The Colorado River System: 3582, 845.

—Through its northern tributary, the Green River (3610), the Colorado derives some of its waters from the region just a few miles west of the headwaters of the Missouri System. Through the Grand (840 map), and the San Juan (3610 map), it reaches almost to the headwaters of the Platte and the Rio Grande respectively. Its southern tributary the Gila (202) flows from the almost desert regions which mark the upper tip of the Sierra Madre.

B. Columbia River System: 3582, 845.

—The Columbia itself rises from that part of the Canadian Rockies which also is the source of streams flowing into Hudson Bay and the Arctic Ocean. Its first tributary, the Kootenay or Kootenai (2309 map), rises in the same range. However, through the Clark Fork (846) and Missoula (2309 map), and through its greatest tributary, the Snake (2594), the Columbia River derives much of its flow from that great highland of the Rockies which likewise feeds the Missouri and the Colorado River Systems. Other tributaries are the Spokane (3328), the Okanogan (3687 map), the Deschutes (2596 map), and the Willamette (2594).

C. The Yukon River System: 604, 3582, 3835.

—The Yukon drains the northernmost ranges of the Cordilleras, pouring its waters into the Bering Sea. Its chief tributaries are the Lewes, the Pelly, the Porcupine, the Tanana, and the Koyukuk: 3835.

D. Other Rivers Emptying on the West Coast:

—You will notice from a glance at the map of North America that, with the exception of the Colorado, the Columbia, and the Yukon, no rivers of great importance empty into the Pacific Ocean. The scarcity of great streams along this vast expanse of seaboard is due to the fact that the great Cordillera ranges crowd so close to the coast that the westward drainage area is small. The water poured down from the western slopes of the Great Divide either gathers into the land-locked lakes such as the Great Salt Lake (1515) and others in the Great Basin, or it wanders about until it finds its way into one of the three great river systems which have managed to cut their way through the coast ranges to the sea.

—The coastal rivers worthy of attention are the Fraser (512) of Canada, the Sacramento-San Joaquin System (581), which drains the west slope of the Sierra Nevadas, and the following rivers pouring from the Western Sierra Madre of Mexico: Sonora, Yaqui, Fuerte, Lerma, and Balsas (2208 table).

IV. RIVERS FLOWING INTO THE ARCTIC OCEAN AND HUDSON BAY:

- **A. The Mackenzie-Athabaska River System: 604, 2102.**
  - —This system includes not only such river branches as the Athabaska and Peace (82), Slave and Liard (2102), but also innumerable lakes of northwestern Canada, of which the most important are Lake Athabaska (3128), Great Slave Lake, and Great Bear Lake (2102)—all of which pour their waters through the Mackenzie into the Arctic Ocean.
- **B. The Nelson-Saskatchewan River System: 604.**
  - —This river system, through the North and South Saskatchewan (3129), derives part of its flow from the Rocky Mountains near the headwaters of the Columbia and of the Milk River tributary of the Missouri. Through its Red River (2986) branch, however, it reaches far to the south near the headwaters of the Mississippi. Among the many lakes which form part of this system are Lake of the Woods (3752), Lake Winnipegosis (map between 602 and 603), Lake Manitoba (2137), and Lake Winnipeg (2986). The waters of this system are discharged into Hudson Bay through the Nelson River (1690).

Note: Before leaving the study of North American rivers, you should review them as a whole with the aid of the map, noting the relation between the great mountain ranges and the various great river systems, distinguishing those regions which are abundantly watered from those where few streams are found, and remembering that the course of rivers provides one of the best possible indications about the general slope and formation of the land surface. Bear in mind also the importance of rivers as waterways and as sources of water power, remembering that those which flow across plains are more likely to be navigable, while those through mountains are more likely to provide the swift and tumbling current suitable for power plants.

CLIMATE, VEGETATION, AND ANIMAL LIFE

V. CLIMATE OF NORTH AMERICA: 794–5, 2515.

- **A. Conditions in the Far North:**
  - **a. Labrador's Climate**—Illustrating how the cold belt reaches much farther south on the east coast than on the west coast: **1948, 2558–9.**
    - **1.** Effect of the Arctic winds: 1948.
    - **2.** Effect of the Labrador Current: 1948.
  - **b. Alaska and the Yukon Territory: 77, 3836.**
    - **1.** How the land near the coast is warmed by the Japanese Current: **77.**
    - **2.** Cold increases toward interior: 77, 3836.
  - **c. Inside the Arctic Circle: 190.**
- **B. Conditions in Mexico: 2210.**
  - —How the hot climate of the coast is tempered in the interior by the altitude of the great Mexican Plateau: 2210.
- **C. Typical Temperate Zone Climate of Southern Canada and the United States: 606, 3587–8.**
  - **a. Climate of the Great Central Plain:**
    - **1.** Extremes of variation due to the fact that this vast region is open at once to cold winds from the north and hot winds from the south: 3587, 794.
    - **2.** How these extremes are tempered in the Great Lakes region: **1510.**
  - **b. Climate of the Atlantic Coast and Gulf Plain:**
    - **1.** Effect of the prevailing westerly winds: 3588.
    - **2.** Effect of the warm waters of the Gulf of Mexico: 1548.
  - **c. Climate of the Pacific Coast:**
    - —Moderating influence of the winds from the Pacific Ocean: **3588.**
- **D. Rainfall in North America: 3588, 2972–4.**
  - **a. Rainfall Map facing page 2514.**
  - **b. Effect of Mountains on Rainfall: 2973, 795.**
    - **1.** Appalachians so low that moist winds from Atlantic easily pass over them, carrying rain to the eastern part of the Great Central Plain: 2516.
    - **2.** Cordilleras so high and broad that moist winds from Pacific are quickly cooled and forced to deposit their moisture near the coast: 2517, 606.
    - **3.** This accounts for the arid and semi-arid condition of the Great Basin deserts and of the western plains.

VI. VEGETATION OF NORTH AMERICA: 1327, 3534.

—See Vegetation Map facing page 2514.

Note: The number of small flowering plants and grasses which are native of North America is so great that it would be impossible to list them here. We shall therefore confine ourselves with few exceptions to the characteristic trees and shrubs of the various regions. The mention of a tree as belonging to one region does not mean, of course, that it is confined to that region, but merely that that region is its most natural habitat.

- **A. The Arctic Tundras and Northern Barrens: 1948 (picture), 190.**
  - —Reindeer Moss 1994; Dwarf Willows, Junipers, and Birches.
- **B. Southern Labrador, Northwest Canada, and Alaska: 74.**
  - —White Pine 2807 (picture); Alaska Spruce 74; Tamarack 3539· Birches 399; Alder 85.

C. Northern Appalachians and Laurentian Plateau:

—Pines 2807–8; Spruces 3332; Hemlock 1629; Tamarack 3539; Balsam Fir 1248; White Cedar 671; Red Cedar 1903; Juniper 1902; Alder 85; Birches 399; Poplars 2879; Maples 2138: Willows 3742; Quaking Asp 2879 (picture); Beech 364; Ash 225.

D. Southern Appalachians and Gulf Region: 158.

—Yellow Pine and Loblolly Pine 2808; Beech 364; Chinquapin 752; Walnuts 3667; Laurel 1970; Persimmon 2740; Papaw and Sassafras 3533; Holly 1673; Catalpa 660; Magnolia 2123; Palmetto 2647; Tulip Tree 3547; Pecan 2705; Tupelo or Sour Gum 3533; Bald Cypress 946; Live Oak 2547; Cane 3386.

E. Central Mississippi Valley:

—Red Cedar 1903; Juniper 1902; Oak 2547; Beech 364; Maple 2138; Elm 1138; Chestnut 718; Black Walnut 3667; Hickory 1647; Red Mulberry 2366; Willows 3742; Butternut 548; Buckeye 523; Locust 2045; Sycamore 3424; Sumac 3390.

F. Great Western Plains, Great Basin, and Cordillera Plateaus:

—The most characteristic plants of the plains and plateaus are the Cottonwood (2880), and Sagebrush (3103); the semi-desert regions of the Great Basin present many varieties of Cactus (2829), the Yucca (3835), and, further south, certain species of Acacias (4).

G. Rocky Mountains:

—The higher slopes of the Rocky Mountains produce principally a wide variety of conifers such as the Western Yellow Pine (2808), Spruces (3332), Hemlocks (1629), and Tamaracks (3539); other trees are Cottonwood and Balsam Poplar (2880), and Willows (3742).

H. Pacific Coast Ranges:

—Here are some of the finest evergreen forests in the world: characteristic of the coast ranges of Canada, Washington, and Oregon are the Douglas Fir and Silver Fir (1248), and Western Hemlock (1629); the California ranges have in addition the famous Redwoods (3533), Sequoias (3175), and the Eucalyptus (1186).

I. Mexican Vegetation:

—The interior mountains and plateaus of Mexico have much the same scanty vegetation as the plateaus and semi-arid regions to the north: the coastal strips, however, produce a rich tropical growth including Palms (2647), Rosewood (2728), Mahogany (2124), Brazil-Wood (1779, 3284), Ebony (1073), Giant Ferns (1232), Orchids (2593), Agave (42), and a great variety of tropical fruits.

VII. ANIMAL LIFE OF NORTH AMERICA:

A. Mammals: 2132.

a. Deer Family: 979.

—American Elk or Wapiti 3669; Virginia Deer 980, 981 (picture); Mule Deer 980 (picture), 981; Black Tailed Deer 980; Moose 2325; Caribou or Reindeer 76 (picture).

b. Ox, Sheep, and Antelope Group: 3198, 146.

—Bison or "Buffalo" 428; Musk-Ox 2383; Rocky Mountain Sheep 3198; Rocky Mountain Goat and Pronghorn Antelope 146.

c. Dog Family:

—Coyote and Gray Wolf 3774; Red Fox 1336; Silver Fox, Arctic Fox, and Gray Fox 1337.

d. Bear Family: 349.

—Polar Bear, Grizzly Bear, and Alaska or Kadiak Brown Bear 355; American Black Bear 350.

e. Weasel Family:

—Wolverine 3776; American Marten 2156; Weasel 3707; Ferret 1234; Mink 2251; Skunk 3246; Badger 303; Otter and Sea Otter 2605.

f. Cat Family: 658.

—Cougar, Puma, or Mountain Lion 2933–4; Jaguar 1859; Ocelot 1989; Canada Lynx and Wild Cat or Bob Cat 2087.

g. Rodents or Gnawing Animals: 3036.

—Gray Squirrel and Flying Squirrel 3333; Red Squirrel, Fox Squirrel, and Ground Squirrel 3334; Chipmunk 752; Woodchuck 1543; Prairie-Dog 2912; Beaver 356; Porcupine 2883; House Rat and Wood Rat 2977; House Mouse and Field Mouse 2359; Muskrat 2384; Kangaroo Rat 1908; Jumping Mouse 1647; Pocket Gopher 1488; Polar Hare 1585; Varying Hare or "Snowshoe Rabbit," Prairie Hare or "Jack-Rabbit," and Cottontail Rabbit 1584.

h. Other Mammal Groups:

—Peccary 1671 (picture), 2706; Raccoon 2951; Armadillo 211; Mole 2278; Shrew 2279; Brown Bat and Red Bat 346; Opossum 2585, 1908.

B. Birds: 400.

—Birds peculiar to North America: Wild Turkey 3556; Mocking-Bird 2274, 419 (picture); Robin 3028, 420 (picture); Baltimore Oriole 2600 (picture), 2601; Bobolink 446; Cowbird 433, 404 (picture); American Flycatchers 1313, 417 (picture); Cat-Bird 2410 (picture); Sage Hen 1545. These and other characteristic American birds will be found pictured and described beginning on page 413.

C. Reptiles and Amphibians: 2997.

—Horned Toad and Gila Monster 2037; Iguanas 685; Rattlesnakes 2978; Copperhead 884, 3258 (picture); Moccasin 2274, 3258 (picture); Coral Snake 3260, 3258 (picture); Alligator 98; Crocodile 922; Terrapin

3563; Box Tortoise 3562; Snapping Turtle 3563; Leopard Frog 1373; Bullfrog, Tree Frog, Peeper 1375; American Toad 3507; Salamanders 3112; Newts or Water-Dogs 3113.

Note: North American snakes other than those mentioned on preceding page will be found described in the article on Snakes, page 3257.

- **D. Fish: 1271, 1278-9.**
    - —Salmon 3113; Eel 1089; Sunfish 1279; Trout 3545; Whitefish 3733; Striped Bass, Bluefish, and Cod 1278; Haddock 1558; Halibut 1565; Mackerel 2102; Pompano and Redfish 1279; Shad 3188; Smelt 1279; Tarpon 3438; Tuna 3552; Tilefish 1279; Flounder 1301, 1289; Flying Fish 1314; Sawfish 3131; Sharks 3196; Skates or Rays 3244; Swordfish 3423.
- **E. Insects and Allied Groups: 1789.**
    - —The number of North American insects and similar creatures is so great that we shall list here only those which, by their depredations, play an important part in the agricultural life of the continent: Aphids 154; Grasshoppers 1503; Locusts 2045; Chinch Bug 752; June Bug 1902; Hessian Fly 1645; Potato-Bug 2902; Weevils 3713; Army-Worm 218; Codlin Moth 820; Cankerworm 630; Cutworm 944. A few others will be found mentioned in the article on Beetles, page 366.

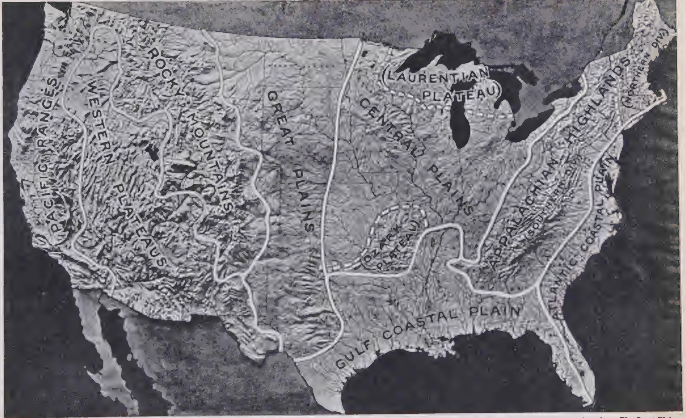
MANKIND IN NORTH AMERICA

- VIII. DISCOVERY AND EXPLORATION:
    - **A. Early Visits of the Northmen: 109, 2526-7.**
    - **B. Columbus and His Voyage: 846, 109.**
        - —How Sugar Helped Discover America: 3385.
    - **C. How America Got Its Name: 3634.**
    - **D. Three Hundred Years of Discovery after Columbus: 109-10.**
        - **a. John Cabot, the First to Reach North America: 561.**
        - **b. Ponce de Leon and the "Fountain of Youth": 2878, 1295.**
        - **c. How Cortez Conquered Mexico for Spain: 894, 288.**
        - **d. How Cartier Opened the Gateway of Canada for France: 651.**
        - **e. De Soto and His Adventures on the Lower Mississippi: 999.**
        - **f. Coronado, the First White Man on the Great Plains: 892.**
        - **g. Sir Walter Raleigh's Ventures in the New World: 2974.**
        - **h. Henry Hudson and His Great Discoveries: 1690.**
        - **i. Champlain and the Founding of Quebec: 687.**
        - **j. The Exploration of the Mississippi:**
            - —Marquette 2151; Joliet 1900; La Salle 1964; Hennepin 1632.
        - **k. Daniel Boone Penetrates the Wilderness: 464.**
        - **l. The Famous Lewis and Clark Expedition: 1989.**
- IX. PEOPLES OF NORTH AMERICA:
    - **A. Original or Native Population:**
        - **a. Prehistoric Races:**
            - **1.** Mound Builders: 2357, 1767.
            - **2.** Cliff Dwellers: 793.
        - **b. Natives Found by White Men:**
            - **1.** Eskimos: 1174.
            - **2.** Northern Indians: 1765.
            - **3.** Mexican Types:
                - —Aztecs 288; Mayas 3834.
    - **B. White Population:**
        - **a. Early Settlers:**
            - **1.** The Spaniards:
                - —In Mexico 2214, 2219; in Florida 1295; founding of St. Augustine 3106; in New Mexico 2466; in Texas 3478; San Antonio 3121; in California 580; San Diego and San Francisco 3124; Los Angeles 2063; in Arizona 202.
            - **2.** The French:
                - —In Canada 617; on the St. Lawrence River 617; founding of Quebec 2948; Montreal 2317; on the Great Lakes 1514; in Wisconsin 3772; in Illinois 1736; in Michigan 2226; Detroit 999; in Louisiana 2072; New Orleans 2471; in Missouri 2272.
            - **3.** The Dutch:
                - —In New York 2486; in Delaware 989.
            - **4.** The English:
                - —In North Carolina 2520; in Virginia 3650; Jamestown 1861; in Massachusetts 2170; Plymouth 2164, 2175; Puritans 2937; in Rhode Island 3009; in Maryland 2163; in South Carolina 3292; Charleston 699; in Pennsylvania 2720; Philadelphia 2760.

Note: The political history of these early settlements, and how they finally merged into the states and nations of today can be studied best by reference to the History Outlines.

- **b. Later Immigration to North America: 3579, 3581, 610, 617.**
- **c. Negroes Imported as Slaves: 2434.**

THE GREAT NATURAL REGIONS OF THE UNITED STATES


PACIFIC RANGES
WESTERN PLATEAUS
ROCKY MOUNTAINS
GREAT PLAINS
CENTRAL PLAINS
(LAURENTIAN PLATEAU)
(OZARK PLATEAU)
GULF COASTAL PLAIN
ATLANTIC COASTAL PLAIN
APPALACHIAN HIGHLANDS
(SOUTHERN DIV.)
(NORTHERN DIV.)

Here we see the eight great natural regions of the United States, with three subdivisions. Mastery of this regional grouping is important to the student of geography, because not only does it determine physical features, such as the flow of rivers, but to a great extent indicates the activities pursued by the people within the regions. As we might expect, agriculture rules the plains regions. The Gulf Plain raises products suited to a warm climate. The Central Plains produce crops typical of a temperate climate, and the Atlantic Plain shades from one to the other. The Great Plains, due to their comparative lack of water, are more suited to cattle raising — and the lack of water may be understood from the map, because the mountains farther west block off the rains from the Pacific. In similar ways, the physiography of the other great regions shown exercises profound influence upon the lives of their people, as explained in the Outline.

- **C. Distribution of Population and Its Causes:**
  —See Population Map facing page 2514.
  - **a. Fine Harbors on East Coast Attract Settlers: 2514.**
  - **b. Influence of Fisheries on Colonization: 1283.**
  - **c. Influence of Fur Trade on Exploration: 1389.**
  - **d. Appalachian Mountains Halt English Settlers: 158, 2515, 3581.**
    —But this proves more fortunate than the rapid scattering of Spanish and French settlements, for it helps to weld the colonists together: 2515.
  - **e. How Settlement Spread Beyond the Appalachians: 158.**
  - **f. The Lure of Gold Leads Men over Plains and Mountains: 2515.**
  - **g. Factors in the Permanent Settlement of the Continent:**
    - **1.** The discovery of its vast natural resources: 2515.
    - **2.** Areas of Barren Land comparatively small: 2515.
- **D. The Story of the Seven Strands of the Rainbow: 3582.**
  —This is the story of the United States and of the influences which helped to bring about its remarkably rapid and prosperous growth. Read this story carefully before going on to the next Outline, which takes up the United States, region by region.

UNITED STATES

THE DEVELOPMENT of the United States during the last century is one of the marvels of civilization. Nowhere has such a vast tract of wilderness been so rapidly conquered. In growth of population, in industrial progress, in the creation of material prosperity, the record of this country has never been equalled. Natural conditions strongly favored this development. The territory which came into the possession of the United States occupied the heart of the temperate zone; the varied climate and fertile soil permitted the cultivation of nearly every kind of crop; the natural resources—minerals, timber, water-power, etc.—were abundant and widely distributed; the coast-lines, divided between the two great oceans, encouraged commerce with Europe and Asia.

Here, indeed, was the land of opportunities. And the people who came into this favored land were of a kind to take advantage of these opportunities. First, we see the early colonists and their descendants—men of bold, liberty-loving stock, who framed the ideals of the new nation. Then came enterprising seekers after freedom and fortune, pouring in from every part of Europe—farmers, tradesmen, miners, skilled artisans, laborers, professional men, students, representing every class and creed. Differing widely in racial temperament, in traditions, and in training, they amalgamated to form a versatile population ready to meet any emergency and to fit into any enterprise which their adopted country might set before them.

The study of the natural resources of the country and of the multitude of uses to which they have been put by the labor and inventive genius of the people—these are the most interesting and important points in the Geography of the United States. From this point of view, the territory of the United States can be roughly divided into several *natural regions*, each of which is particularly adapted to certain classes of industries and occupations. The boundaries of these natural regions, however, do not usually coincide with state boundaries. For this reason the tendency in American schools has been to abandon the old method of studying the states one by one or in definite groups. Instead, they make a survey of the country as a whole, noting the characteristics of each natural region, the influence each region exerts upon the life of the people dwelling in it, and the contribution each region makes to national strength and prosperity. The same method and spirit is followed in this Outline. Those wishing to study any of the states by themselves will find full geographical and historical details gathered together in each state article.

NORTHERN DIVISION OF THE APPALACHIAN HIGHLANDS

THIS region, which includes all of New England, is today essentially a manufacturing district. The surface of the land is generally broken and rocky, the only portions suitable for farming on an important scale are the narrow river valleys and lake bottoms. The result is that New England has to import a large proportion of its foodstuffs and the raw materials for its great textile industries. The extensive forests in the north contribute chiefly the wood-pulp used in the paper mills. While poor in metals, the rock-ribbed hills of the interior yield building stone of great value. An inexhaustible source of power is found in the swift streams. But it is not by reason of its natural resources that New England occupies such an important place in the life of the United States, but because of the energy and enterprise of its citizens who have built up great industrial and financial centers where a large proportion of the national and international business is transacted.

I. BOUNDARIES AND AREA:

- **A. Hudson River and Lake Champlain on the west; Canada on the north; the Atlantic Ocean on the east; and Long Island Sound on the south.**
- **B. Area includes the six New England states—Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island—and the narrow strip of New York east of the Hudson.**

II. PHYSIOGRAPHY:

—The geological formations of the Appalachian regions are fully reviewed in the Outline on North America. Here we shall examine merely those physical details peculiar to the northern or New England Division.

- A. **Important Mountains:**
  - a. **White Mountains 2453; Green Mountains 3630; Berkshire Hills 2168.**
  - b. **Mount Washington the Highest Peak 2453.**
- B. **Effects of the Ice Age in New England: 1720, 3632.**
- C. **Effects of Sinking of the Land upon the Coast-line: 2517.**
- D. **Rivers and Lakes:**
  - a. **Principal Rivers:** Connecticut 864, 2454; Penobscot 2126; Merrimack 2454; Androscoggin and Kennebec 2125.
  - b. **Numerous Lakes, Mostly Small**—Largest Lakes: Lake Champlain 3632; Moosehead Lake 2128.
- E. **Soil—Great Variation in Quality: 2126, 864, 2169, 3007, 3632.**

III. CLIMATE:

- A. **Sharp Seasonal Changes: 2516, 2128, 3632.**
- B. **Abundant Rainfall: 3588, rainfall map opposite page 2514.**

IV. NATURAL RESOURCES:

- A. **Good Natural Harbors: 2517, 2125.**
  - —Boston 469; Portland 2128; Fall River 1223; New London 866–7; New Haven 2456; Providence and Newport 3008, 2927; Portsmouth 2454; Bridgeport 510; New Bedford 2448; Bath 2126.
- B. **Numerous Streams, Waterfalls, and Rapids:**
  - a. **Abundant Water-Power: 863, 2126, 2169, 2454, 3008.**
    - —Large water-power sites: Lawrence 1973; Lowell 2075; Nashua and Manchester 2454; Concord (N. H.) 2455; Lewistown 2128; Fall River 1223; Holyoke 2165: Pawtucket 3007, 3008 (picture); Woonsocket 3010; Burlington and Montpelier 3633.
  - b. **Inland Navigation:**
    - —Important cities situated at the head of navigation: Hartford on the Connecticut 867, 1595; Augusta on the Kennebec 2126; Bangor on the Penobscot 2126.
- C. **Forests: 1327, 2126, 3632, 2454, 866.**
- D. **Minerals:**
  - —Marble, Granite, Limestone, Slate: 3633, 2128.
- E. **Fish, Oysters, Clams, Lobsters: 1283, 2166, 2128, 3008.**
- F. **Some Good Agricultural Land: 864, 2126, 2454, 3632.**
- G. **Beautiful Scenery: 2125, 2168, 2453, 3633.**
  - —Notable Summer Resorts: Newport 3008, 3010 (picture); Bar Harbor 2128.

V. CHIEF INDUSTRIES:

- A. **Manufacturing the Leading Industry:**
  - a. **Textiles:** Woolens and Cotton Goods 1973, 863, 2165, 2454; Silks 863, 3007.
  - b. **Wood Products:** Wood-Pulp and Paper 2454, 2126, 2165, 1973.
  - c. **Boots and Shoes:** 2165, 2454, 2126.
  - d. **Food Products:** Canning 2126; Maple Syrup and Maple Sugar 3632, 2138.
  - e. **Miscellaneous Manufactures:** Brassware, Plated Ware, and Cutlery 863; Machinery and Leather Goods 2166; Clocks and Watches 863; Firearms 1595, 2456, 863; Jewelry and Silverware 2927; Wire 3787, 2166; Rubber Products 863.
- B. **Lumbering: 2126, 2454, 3632.**
- C. **Quarrying and Mining:**
  - —Granite and Marble Quarrying 3632, 2454, 2128, 2944 (picture); Limestone, Slate, and Talc 3633, 3590; Feldspar, Lime, Cement, Iron 866.
- D. **Fisheries: 2166, 3008, 2454, 2128, 864.**
- E. **Shipbuilding: 2126, 863.**
- F. **Agriculture:**
  - —Hay 2126, 3632, 864; Apples and Pears 2126, 3632, 864; Blueberries 2126; Potatoes 2126, 3632; Garden Vegetables 864, 3007, 2454; Tobacco 864, 3509.

VI. PRINCIPAL CENTERS OF MANUFACTURING AND TRADE:

—Boston 469–73, Providence, 2927, Worcester 3787, New Haven 2456, Bridgeport 510, Hartford 1595, Springfield 3332, New Bedford 2448, Fall River 1223, Lowell 2075, Cambridge 587, Lynn 2087, Lawrence 1973, Somerville 472, Waterbury 864, Portland 2128.

THE ATLANTIC COASTAL PLAIN

WHEREAS the Appalachian Highlands in the north reach to the Atlantic Ocean, forming the rocky and broken coast of New England, their southern ridges and plateaus are separated from the sea by a strip of lowland which geographers call the Atlantic Coastal Plain. This plain is composed of layers of soil washed down from the ancient mountains. A natural boundary called the "Fall Line" separates this region from that part of the Appalachian Highlands known as the "Piedmont Plateau." Here the rivers, emerging from the western hills, plunge in falls or rapids to the plains below, at the same time putting an end to up-stream navigation from the sea and providing a rich source of water-power. The Atlantic Coastal Plain is at once a manufacturing and an agricultural region. Its chief manufacturing and trade centers are grouped around the great natural harbors to the north; its agricultural districts become increasingly important toward the south.

I. BOUNDARIES AND AREA:

—Cape Cod, Marthas Vineyard, Nantucket Island, Long Island, and Staten Island are portions of the Atlantic Coastal Plain which, when this part of the coast sank and let in the sea, were cut off from the remainder. The mainland plain includes southern New Jersey, Delaware, the eastern sections of Maryland, of Virginia, of North Carolina, and of South Carolina, the southern half of Georgia, and the eastern coast of Florida. New York City and Philadelphia, although they are not, strictly speaking, in coastal plain territory, are included here because their commercial life is so closely linked with the Atlantic seaboard.

II. PHYSIOGRAPHY:

- A. General Characteristics of the Surface:
  - a. Flat and Inclined to be Swampy near the Coast: **987, 3647, 2518, 3290, 1431.**
  - b. Elevation above Sea-level less than 500 Feet: **2457, 988, 3647.**
- B. Contrasts in the Coast-line:
  - a. Effects of the Sinking of the Land in the North: **2790, 2517.**
    - **1.** Great Bays and Wide River Mouths: Delaware Bay 989; Chesapeake Bay 716; New York Bay (Hudson River mouth) 1692; Hampton Roads (mouth of the James River) 3647; Potomac River mouth 2902.
    - **2.** Islands and Sounds: Marthas Vineyard and Nantucket Island 2170; Long Island 2061, and Long Island Sound 2482; Manhattan Island 2488; Albemarle and Pamlico Sounds 2518.
  - b. Effects of the Rising of the Land in the South:
    - **1.** Regular coast-line with no large bays or inlets: 2517.
    - **2.** Low sandy shores and swamplands in many places: 3290, 1431 (Okefinokee Swamp), 1298 (Everglades).
- C. Chief Rivers:
  - —Delaware 989; Potomac 2902; Rappahannock, York, James, and Roanoke 3648; Cape Fear River 2518; Savannah 1432; Altamaha with its two tributaries, the Oconee and Ocmulgee 1432 (map); St. Johns River 1297.
- D. Character of the Soil:
  - a. Light and Sandy: **640, 2460, 987, 1298.**
  - b. Flat and Rich: **987, 3290, 1431.**

III. CLIMATE: **3588.**

- A. While rainfall is fairly abundant and evenly distributed over this region, there exists a great contrast in temperatures between the northern and southern portions. The extent of this variation may be judged from the fact that great summer resorts exist in the north, while famous winter resorts abound in the south.
- B. Effect of Gulf Stream 255: Violent Coastal Storms 2518.

IV. NATURAL RESOURCES:

- A. Good Farm Land: **640, 2460, 987, 1298, 3290, 1431.**
- B. Minerals: Phosphate Rock **3291**; Clay **2458, 987, 2162, 3292, 1433**; Kaolin **2519** (picture); Sand of Fine Quality **2460**; Fullers Earth **1298.**
- C. Forests: Pine **2457, 2519, 3292, 640, 1432, 1297**; Cypress **3292**; Oak **640.**
- D. Fish: Shad **3188**; Pompano **1279**; Spanish Mackerel **2160.**
  - —Oysters, crabs, and terrapin 2160, 3648.
- E. Natural Harbors and Navigable Rivers: **987, 1296, 3647, 2457.**
- F. Water-power: **2519, 3290, 1432.**
  - —The water-power available on the Atlantic Coastal Plain is virtually all developed at the Fall Line where the streams from the Appalachians plunge downward from the Piedmont Plateau. In this sense it really belongs to the upland regions rather than to the plain. There have grown up, however, along this Fall Line, many important industrial centers which owe their prosperity not only to the available water-power but also to the fact that they are situated at the head of the navigable streams of the plains region.

V. INDUSTRIES:

- A. Agriculture:
  - a. Truck Farming and Fruit Raising in the North: **987, 2457, 2160, 2518, 3648.**
    - —Intensive cultivation of the soil in the vicinity of large cities to supply their markets.
  - b. Fruit Growing in the South: **1431, 1297.**
  - c. Corn an Important Crop: **2518.**
  - d. Cotton: **3290, 2518, 1431.**
  - e. Tobacco: **2519, 3648.**
  - f. Other Crops: Rice **3291**; Peanuts **3648**; Sugar Cane **1431**; Pecans **1431.**
- B. Manufacturing: **2496, 2457, 3650, 2519, 1432, 987, 2162.**
  - a. Cotton Products: **3650, 2519, 1432.**
  - b. Wood Products: Lumber 3650; Furniture 2519, 1432; Paper and Wood-pulp 987; Charcoal and Lampblack 1432; Turpentine, Resin, Tar, Pitch, and Creosote 2519, 1432.

c. **Miscellaneous Manufactures:** Silk 2458; Clothing 2162; Leather 3650, 987; Linoleum and Oil Cloth 2458; Shipbuilding 2458, 987, 2762, 3743; Explosives 3743.
d. **Manufacturing Favored by Position near Coal Fields: 2457.**

C. **Trade and Transportation:**
a. **Means of Transportation:** Railroads 2495, 2162, 1296; Rivers 1296, 3648, 987, 2518, 3292; Canals 640, 987.
b. **The ports of the Atlantic Coastal Plain are the principal gateways for trade with Europe: 2496, 2762, 322, 3743, 2513.**

VI. **IMPORTANT CITIES:**
A. **Seaports:** New York City 2487; Philadelphia 2760; Baltimore 332; Jersey City 1884; Richmond 3018; Wilmington (Del.) 3743; Norfolk 2513; Elizabeth 2457; Jacksonville 1858; Hoboken 2457; Savannah 3130; Charleston 699; Wilmington (N. C.) 2520; Newport News 3650.
B. **Industrial Centers on the Fall Line:** Trenton 3540; Columbia 3290; Augusta, Milledgeville, Macon, and Columbus 1431.

SOUTHERN DIVISION OF THE APPALACHIAN HIGHLANDS

HERE WE HAVE one of the busiest mining and industrial regions in the world. Coal is king. From the ancient seams of the mountains there pours forth a vast volume of fuel which lights the furnaces of thousands of factories. Drawing raw materials—iron ore chiefly—from the western districts, and provided with a convenient outlet for manufactured products to the east, this busy territory sets the pace for all other American industrial life.

I. **BOUNDARIES AND AREA:**
A. **The Hudson River forms the northeastern boundary of the southern Appalachians. Proceeding further toward the south, the region takes in all of New York State, except a thin strip along Lake Erie and Lake Ontario and a narrow border east of the Hudson; northern New Jersey; all of Pennsylvania excepting the Atlantic and Lakes ports; the eastern mountainous parts of Ohio, Kentucky, and Tennessee; all of West Virginia; the western portions of Maryland, Virginia, North Carolina, and South Carolina; and the northern sections of Georgia and Alabama.**
B. **Included in this region are all the southern ridges of the Appalachian Mountains proper, the Piedmont Plateau, the Cumberland Plateau, the Allegheny Plateau, and other regions composing the western Appalachian Highlands. The Adirondacks, although they are geologically part of the Laurentian Plateau to the north, are included because their industrial life focuses southward rather than toward the St. Lawrence River Valley.**

II. **PHYSIOGRAPHY:** The geological formation of the entire Appalachian region is fully reviewed in the Outline on North America on page 3870. Here we shall emphasize merely some of the more important details peculiar to this southern portion.
A. **Important Mountains: 158, 3720, 2517.**
a. **Allegheny Mountains 2160, 3720; Blue Ridge Mountains 70, 2160, 3647; Cumberland Mountains 1916, 3465; Great Smoky Mountains 3465; Lookout Mountain Ridge 70.**
b. **Character of the Mountains: 158, 2717, 3720.**
c. **How Catskills are a Part of the Appalachians: 1692.**
d. **Adirondacks: 25. Classed by Geologists as part of the Laurentian System: 25, 3870.**
B. **Plateaus: Piedmont 70, 1431, 2518, 3290, 3720, 3647; Cumberland 70, 3720; Allegheny 2718, 2567, 3465.**
C. **Rivers.**
a. **Geologic History; 158, 1916, 1692.**
b. **Large Rivers**—Hudson River 1692, 2481 (picture); Ohio River 2568, 2572–3, 3720; Susquehanna 2721; Delaware 2721; Potomac 3641; James 3648; Roanoke 3648; Savannah 3290.
c. **Gaps:** These gaps in the mountains, caused by eastward-flowing rivers, were and are of great importance to the transportation of goods and settling of land. 3581.
—Hudson-Mohawk Gap 2484; Delaware Water Gap 2718; Cumberland Gap 1916.
D. **Lakes:**
a. **Lakes Due to Action of Ancient Glaciers: 1957, 1721, 2516.**
b. **Few Lakes in South:** This is due to fact that ice cap which projected southward during the Ice Age did not reach below the Ohio River: 3872.
E. **Soil:**
a. **Glacial Soils: 2485, 2571.**
b. **Residual Soils:** In Valleys 2518, 3648, 2457; Plateaus 2160, 1431, 3290; On Rocky Highlands 2518, 3648, 3650.

III. **CLIMATE:** The great variety of climate is due to varying altitudes and the enormous north-and-south extent of this region: 72, 3290, 3720.

IV. **NATURAL RESOURCES:**
A. **Minerals: 3590.**
a. **This Section Noted for Rich Mineral Supply:** Coal Most Important 812, 70, 1919, 3650, 3722, 2570, 1432, 2162; Oil 2720, 2570, 1919, 3723; Gas 2570, 1919, 70, 3723: Mineral Springs 3720, 3648, 3466; Salt 3723.

b. **Metals:** Iron 1919, 70, 3650, 1432; Gold 1432, 2520; Bauxite 1432.
c. **Stone:** Granite 3292; Limestone 2720, 1919, 70.
B. **Forests: 2572, 72, 2721, 1431, 2518, 1919, 3291, 3650, 3720.**
—Government Conservation: 2721.
C. **Water Power: 2482, 3466, 1431, 2519, 3290, 2160.**
—Future Water Power in Muscle Shoals: 72.
D. Good Soil: **2485, 2721, 2570.**

V. CHIEF INDUSTRIES:
A. **Mining:**
a. **Coal: 2720, 3722, 1919.**
b. **Iron: 70, 3650.**
c. **Copper: 3468.**
d. **Stone:** Marble 2144, 1432; Granite 1497.
B. **Other Mineral Products:**
a. **Petroleum and Natural Gas: 2720, 3722.**
b. **Clay: 2570.**
C. **Agriculture and Live Stock:**
a. **Agricultural Products of this Region are Almost as Important as the Minerals.**
b. **Piedmont Plateau Excellent Farmland: 1431, 2518.**
c. **Crops:** Corn 2518, 3291, 3648; Winter Wheat 2721, 2160; Potatoes 2485, 2721; Hay 2485, 2721; Cotton 2518, 3290; Tobacco 2519, 3509; Vegetables 3291.
d. **Dairy Products: 2485.**
e. **Live Stock: 2721, 3722.**
D. **Forestry Products: Tar, Turpentine, Resin: 72.**
E. **Manufacturing:**
a. **Iron and Steel: 2720, 70–2, 3650, 2162.**
b. **Textiles: 72, 3291, 2458.**
c. **Lumber and Timber Products: 3468, 2721.**
F. **Trade and Transportation:**
a. **General Characteristics of Commerce**—Interstate Commerce Very Important: 2485, 2568, 2721.
b. **Commercial Value of Rivers: 2482, 2721.**
—While many of the important streams of this section do not become navigable until they pass into the Atlantic Coastal Plain, they have their navigable headwater at the Fall Line, giving a water outlet there to the vast mercantile traffic of the interior highlands. Here also is created a source of water power which is available equally to the Atlantic Coast industries and those along the borders of the Southern Appalachian Region. Several important water gaps cut through the Appalachian Highlands, leading from the Great Lakes Plains and Central Plains to the Atlantic Coast waterways.
c. **Canals—Their Early Influence on Trade: 2484, 2568.**
1. Important Canals of Today: 2484.
2. Future: 2721.
d. **Railroads: 2479, 2721, 2568, 72, 2162, 2484.**

VI. IMPORTANT CITIES:
—**A Territory of many Cities, Chiefly Mining and Manufacturing Centers:**
Schenectady 3136; Troy 3545; Syracuse 3425; Rochester 3033; Scranton 3153; Harrisburg 1591; Reading 2983; Pittsburgh 2812; Akron 69; Youngstown 3832; Nashville 2398; Atlanta 254; Birmingham 426.

GULF COASTAL PLAIN

THIS PORTION of the Coastal Plain is not essentially different in a geological sense from the Atlantic Coastal Plain. Its surface, for the most part low and flat, is formed by the accumulated sediment of ages. It is an extremely fertile region, including as it does the lower reaches of the vast Mississippi Valley. The chief point which serves to distinguish it from the Atlantic Coastal Plain is the character of its industrial life. Most of the population is devoted to agriculture. Here we shall find comparatively few large cities, both because the rising coastline has few important natural harbors and because the agricultural pursuits of the inhabitants tend to keep them scattered in small communities rather than concentrated in large groups.

I. BOUNDARIES AND AREA:
—**This division roughly includes that portion of the Coastal Plain bordering on the Gulf of Mexico, the western half of Florida, southern half of Alabama, all of Mississippi, western Tennessee, southwestern Kentucky, the small southeastern tip of Missouri, the southeastern half of Arkansas, a thin southern strip of Oklahoma, all of Louisiana, and the eastern half of Texas.**

II. PHYSIOGRAPHY:
A. General Characteristics of the Surface:
a. **Low and Marshy Where it has Recently Risen from the Sea: 1298, 2261, 3466, 3474.**
b. **Character of the Alluvial Land: 2068.**

- B. Rivers:
    - a. **Mississippi River:** Its early importance 2268; effect of railroads 2268; effect of floods 2262.
    - b. **Mobile River 72; Louisiana Rivers 2068; Florida Rivers 1295.**
- C. Coastline:
    - a. **Mississippi River Delta: 2791.**
    - b. **Shallow Inlets Caused by Rising Land: 3474, 2261.**
      —All Texas harbors have to be dredged: 3474.
- D. **Soil:** Much of the soil is good for Fruit Raising because it is light and sandy 70, 1298; or very fertile because of alluvial deposits or vegetable mold 72, 2261, 3465, 2198, 2068, 3474, 1916.

III. CLIMATE:

- A. **Hot Summers and Mild Winters: 2261, 1917.**
- B. **High Winter Temperatures: 1295, 72, 3473.**
- C. **Influence of Winds from the Gulf:** Warm damp winds bring heavy rainfall 72, 2262, 3473; Tropical Storms 1392.

IV. NATURAL RESOURCES:

- A. **Good Farm Lands:**
- B. **Forest: 1297, 72, 3468, 207, 3473.** Yellow Pine, Cypress, and Oak most important.
- C. **Fish: 1297–8, 2264, 2070.**
- D. **Oil and Gas: 2070, 3473.**
- E. **Minerals:** Phosphate 1296; Sulphur 3889; Salt 2070, 3474.

V. INDUSTRIES:

- A. **Agriculture:**
    - a. **Cotton the Chief Product of this Region:**
        - 1. Texas the leading Cotton State: 3473.
        - 2. Other Cotton producers: 2262, 72, 2576, 1431, 207.
    - b. **Texas Leads this Section in Corn: 3473.**
    - c. **Louisiana Leads in Rice and Sugar Cane: 2068.**
    - d. **Florida and Mississippi Send Fruits to the Northern Markets: 1379, 2262.**
- B. **Petroleum: 2070, 3473.**
- C. **Fish: 1297–8, 2264, 2070.**
  —Oysters, Shrimps, and Terrapins are among the characteristic products of the fisheries.
- D. **Stock Raising: 3473, 2262.**
- E. **Manufacturing:**
    - a. **Lumber the Most Important Product:**
      —Louisiana is next to the state of Washington in output 2071; Arkansas has some of the largest saw-mills 207; Texas (3473) and Florida (1297) are important for Yellow Pine.
    - b. **Manufacturing in New Orleans: 2469.**
      —Good Shipping Facilities and nearness to Natural Gas and Oil. Ship Building.
    - c. **Arkansas has the Largest Car Factory in World: 207.**
- F. **Trade and Transportation:**
    - a. **Commercial Centers:** New Orleans 2468–71; Mobile 2274; Galveston 1392.
    - b. **Trade:** Early history 2071, 2268; foreign trade (note the advantages of the Panama Canal to this region) 2274.
      —Importance of being near to South America: 2274.
    - c. **Transportation:** Early importance of river transportation 2071, 2268; railroads 72, 2198, 2071, 2468, 2274; shipping 2469.

VI. IMPORTANT CITIES:

- A. **Seaports:** Mobile 2274; New Orleans 2468–71; Key West 1921; Tampa 1300; Galveston 1392.
- B. **Inland Cities:** Memphis 2198, 3466 (picture); Dallas 953–4; San Antonio 3121; Houston 1688.

CENTRAL PLAINS AND INTERIOR HIGHLANDS

THIS is the great farming region of the United States and one of the greatest food-producing districts in the world. The vast stretch of gently sloping land which forms the upper Mississippi Valley, the lower Ohio Valley, and the Great Lakes Plain has a gently sloping surface composed chiefly of exceedingly fertile alluvial and glacial soils. Abundant rains and a warm summer climate round out the requirements for successful agriculture. But this is not all. The region possesses extensive waterways, water power, coal, oil, natural gas, and other great mineral resources which have helped to turn many of its sections into great industrial districts—among the richest and busiest in the nation.

I. BOUNDARIES AND AREA:

- A. **This region is bounded on the north by the Great Lakes and the Canadian border, on the east by the Appalachian Highlands, and on the south by the Gulf Coastal Plain. The boundary between the Central Plains and the Great Plains on the west follows a line running approximately straight from the Lake of the Woods on the Canadian border to the southwestern tip of the Ozark Plateau. See map, page 3876.**
- B. **Included in this region are the parts of New York and Pennsylvania which border on the Great Lakes, the western parts of Ohio, Kentucky, and Tennessee; all of Indiana, Illinois, Michigan, Wisconsin, Iowa,**

and Missouri; all but the northwest corner of Minnesota; eastern strips of South Dakota and Nebraska; the eastern half of Kansas; northwestern Arkansas; and northeastern Oklahoma.

- C. The Interior Highlands consist of the Ozark Plateau in the south and the spur of the Laurentian Plateau in the north. These highlands are treated with the Central Plains because of their close geographical and industrial relations with this great region.

II. PHYSIOGRAPHY:

- A. **General Character of the Surface:**
  - a. **Rolling Level Plains: 1757, 1730, 1909, 3466, 1803, 1916.**
  - b. **Interior Highlands:**
    - 1. Ozark Plateau and Mountains: 2269, 2616.
    - 2. Laurentian Plateau: 1970.
      —Highlands in Michigan (2223), Wisconsin (3768), and Minnesota (2254) are part of the Laurentian Plateau.
  - c. **Geologic History of Region:**
    —Interior sea 2516; erosion of ancient mountains 2252; influence of the Ice Age 1720, 2253, 2571.
- B. **Rivers and Lakes:**
  - a. **Chief Rivers: Mississippi 2265; Ohio 2572; Missouri 2273.**
  - b. **Lakes:** Great Lakes 1510; Lake Superior 3397; Lake Michigan 2227; Lake Huron 1704; Lake Erie 1174.
- C. **Soil Formation:**
  - a. **Glacial Soils: 1757, 2571, 2253.**
  - b. **Alluvial Soils: 2269, 1916.**

III. CLIMATE:

- A. **Interior Continental Climate with Extremes of Temperature: 3587, 1806, 2269, 1909.**
  —Influence of the Great Lakes 1510; Influence of the Ozarks 2269.
- B. **Rainfall Plentiful: 1909, 2270, 1806, 2253, 1758.**
- C. **Other Features of Climate:** Prevailing Winds 1510; Cyclones 2270; Winter Ice on the Mississippi 2270; Storms and Ice on the Great Lakes.

IV. NATURAL RESOURCES:

- A. **Rich Agricultural Land Most Important Resource: 2270, 2223, 1731, 1917, 3466, 1803, 1909, 1757, 3294.**
- B. **Minerals:**
  - a. **Coal 811, 813 (picture), 1732, 1760; Oil and Gas 1911, 2570, 2576, 1760.**
  - b. **Metals:** These are found chiefly in the Interior Highlands.
    - 1. Iron: The Mesabi Range is the world's greatest iron-mining center 1816 (picture), 1817; other Iron fields 2223.
    - 2. Copper 881, 2223; Lead 1974, 3771; Zinc 3839, 3771; Aluminum 104, 207.
  - c. **Other Minerals:** Stone and Clay 2010, 2254, 2570, 1497, 3771; Diamonds 1001, 207; Mineral Springs 207, 3771.
- C. **Waterways: 1511, 2568, 2223, 1730.**
- D. **Water Power:** 3770, 2226; Niagara Falls 3695 (picture), 2482 (picture), 2485; Keokuk Dam 1804, 1806; Falls of St. Anthony 2265.
- E. **Forests:** 2224, 3770, 2256, 2270.
- F. **Fish:** 1512, 3771.

V. INDUSTRIES:

- A. **Farming is the Chief Industry:**
  - a. **Corn the Leading Crop: 1803, 1732, 2270, 2430, 1758, 2253, 3770.**
  - b. **Wheat Second in Importance: 1909, 2270, 2430, 2253.**
  - c. **Other Important Crops:** Potatoes 2224, 3770; Tobacco 3508, 1917; Hay 1732, 2254, 3770, 3468; Hemp 1630; Flax 2254, 3770; Sugar Beets 2224.
  - d. **Fruit Thrives on Lake Shores: 2224, 2486.**
- B. **Dairying: 3770; Stock Raising: 1803, 1730, 2254, 1758, 2224, 1917, 2571.**
- C. **Mining:** Details of the mining in this region will be found through the same page references that were given under "Natural Resources—Minerals."
- D. **Manufacturing:** The combination of vast natural resources with easy methods of transportation and ready markets make this region particularly favorable for large manufacturing industries.
  - a. **Metal Products:**
    - 1. Iron and Steel: 1732, 1760, 2570.
    - 2. Automobiles: Michigan leads the world in the production of Automobiles 2224.
    - 3. Farm Machinery: 1733.
  - b. **Food Products:**
    - 1. Meat Packing: Chicago is the greatest Meat Packing center 2180, 1733; other Meat Packing centers 2272, 2430, 2254.
    - 2. Flour: The largest Flour mills in the United States are in Minneapolis 2252, 1304, 1301 (picture).
    - 3. The North-Central states lead in the Vegetable Canning and Milk Canning industries 633.
    - 4. Other Food Products: Prepared Cereals 2224; Beet Sugar 2224.
  - c. **Oil Refining: 1760, 2576.**

d. **Miscellaneous Manufactures:** Furniture 2224, 1736; Drugs and Chemicals 2226; Leather 3770, 2226; Portland Cement 1760; Glass 1760, 2570.

Note: The manufactured products of this region are so numerous and varied, it is impossible to list them all. In the articles dealing with the principal cities which are listed at the end of this section, you will find these products set forth in detail.

VI. TRANSPORTATION:

A. **Water Transportation:**

a. **Importance of Lake Shipping: 1512, 1733, 1760, 2223, 3771, 2568.**

1. Chicago is one of the most important ports in the United States 721.
2. Iron ore from Lake Superior region is shipped over the lakes to ports in Illinois, Indiana, Ohio, and Pennsylvania 1820.

b. **Importance of River Shipping:** Mississippi 2268; Ohio River 2568, 1919 (picture); Missouri 2273.

c. **Principal Canals:** "Soo" 1513, 627; Welland 3716; Chicago Drainage Canal 724, Erie 627.

B. **Railroads:**

—Chief Railway Centers: Chicago 721; St. Louis 3109; Kansas City 1912.

VII. CHIEF CITIES:

—The largest cities of this region were founded at places which, in the early days, were natural points for loading and unloading water freight. When the railroads were built these sites became important terminals and transshipping points.

A. **Lake Ports:** Chicago 721; Gary 1401; Duluth 1047; Detroit 1000; Buffalo 527; Cleveland 792; Toledo 3511; Milwaukee 2246; Grand Rapids 1497.

B. **River Ports:** Cincinnati 766; Dayton 970; Louisville 2073; Minneapolis 2252; St. Paul 3111; St. Louis 3109; Kansas City 1912; Omaha 2581.

C. **Other Important Cities:** Springfield 3331; Indianapolis 1762; Columbus 849; Oklahoma City 2577.

GREAT PLAINS

BETWEEN the Central Plains and the Rocky Mountains and stretching from Canada to Mexico lies that broad belt of almost treeless grassland which we call the Great Plains. Broken here and there by river valleys or by sudden outcroppings of bare and rugged rock, this region is for the most part flat or very gently undulating. Here in the early days roamed the vast herds of buffalo, hunted by the scattered tribes of nomad Indians. As the buffalo disappeared the half-wild cattle of the pioneer ranchmen took their place. Even today most of this semi-arid land is given over to stock raising. But, bit by bit, the wilderness is being brought under cultivation, either with the aid of irrigation or through the special methods of "dry-farming." Coal in great quantities has been found, and oil fields have been discovered. Farms and factories are gradually taking possession of this vast empire.

I. BOUNDARIES AND AREA:

A. **The Great Plains are bounded on the east by the Central Plains, on the southeast by the Gulf Coastal Plain, on the west by the Rocky Mountains, and on the southwest by the Western Plateaus. North to south, the Great Plains stretch from the Canadian border to Mexico.**

B. **This region includes the northwest corner of Minnesota, all of North Dakota, eastern Montana, central and western South Dakota, northeastern Wyoming, central and western Nebraska, eastern Colorado, western Kansas, the northwest tip of Oklahoma, an eastern strip of New Mexico, and central and northern Texas.**

II. PHYSIOGRAPHY: 2790.

A. **Character of the Surface:**

a. **Treeless Prairies: 3581, 2522, 2429, 3294, 3818.**

b. **Black Hills the Only Important Elevation: 3294.**

c. **Badlands: 2522, 3296, 2429.**

d. **Geologic History:** Great Plains were once covered by the sea: 2516.

B. **Chief Rivers:** All the important rivers of this region flow east and southeast. With the exception of the Pecos, the principal streams all form part of the Missouri-Mississippi system.

a. **Missouri River and Its Tributaries: 2273;** Kansas River 1910 (map); Platte 2430; Niobrara 2429; Yellowstone 3830.

b. **Tributaries of the Mississippi:** Arkansas 208; Red River 2576.

—The Pecos River (3476) flows into the Rio Grande.

C. **Character of the Soil:** Rich sedimentary soil for the most part, very sandy and rocky in places: 2429, 2430, 3473, 2524.

III. CLIMATE:

A. **Climate of Continental Type: 3587, 3822, 2524, 2310, 1909, 2464, 3474.**

a. **Modifying Effect of Black Hills, 3296.**

b. **Dryness of Atmosphere Makes Extremes of Climate Less Severe than in Central Plains.**

B. **Prevailing Westerly Winds: 3588.**

C. **Rainfall Less than 20 Inches a Year:** The semi-aridity of this region is the chief feature which distinguishes it from the Central Plains.

a. **High Mountains Cut off Moisture: 2517** (top of page).

b. **Rainfall in Various Parts of Region: 2310, 1909, 2429, 2576, 3294, 3822.**

IV. NATURAL RESOURCES:

A. **Vast Stretches of Grazing Land: 3582, 2522, 2429.**

B. **Fertile Soil Needing Only Irrigation or Special Dry Farming Methods: 840, 2430, 3588.**

C. **Mineral Wealth:**

a. **Extensive Coal Beds: 2522, 2310, 3820, 841.**

b. **Rich Oil Fields: 3820, 2310.**

c. **Black Hills Produce Gold, Silver, Lead, Tungsten, etc.: 3297.**

V. INDUSTRIES:

A. **Stock Raising and Wool Growing the Most Extensive Industry: 2525, 2310, 3820, 2430, 1911, 3473.**

B. **Agriculture:** Irrigation and Dry Farming are rapidly increasing the agricultural output of the Great Plains 1827, 641, 840, 2429, 2430, 842 (picture), 3820, 1909, 1910 (picture), 2310, 2464 (picture), 2465, 3294, 3476.

—**Principal Crops:** Sugar Beets 840, 2310, 3820, 2430, 1909; Wheat 2524, 2310, 840, 1909; Potatoes 2525, 2310, 840, 2430; Rye, Oats, and Barley 2524, 2525, 1911; Corn 2525, 840; Flax 2525, 2310; Hay and Alfalfa 2525, 3820, 2465.

C. **Mining and Oil Refining:** The references given under "Mineral Wealth" describe the mining industry in this region.

D. **Other Industries:** Smelting and Refining, Meat Packing 840.

VI. **CHIEF CITIES:** There are few large cities in the Great Plains region. This is due chiefly to the fact that there are not many great manufacturing industries to bring large numbers of people together.

—**Denver 998; Fort Worth 1333; Pueblo 844; Great Falls and Billings 2312; Cheyenne 3820; Casper and Sheridan 3822.**

ROCKY MOUNTAINS

RISING abruptly from the Great Plains, the Rocky Mountains form a great barrier which comes down from Canada and reaches seven-eighths of the way across the United States toward Mexico. These mountains constitute the most important watershed in North America, giving rise to four of the largest river systems in the United States—the Missouri-Mississippi, the Columbia, the Colorado, and the Rio Grande systems. Vast stores of mineral wealth have been brought to light in these rugged ranges, and many more doubtless await the search of the prospector. In the sheltered valleys agriculture and stock raising flourish, while the swift mountain streams provide a boundless source of water power, little used in the past but which is waiting to turn the wheels of future industries.

I. BOUNDARIES AND AREA:

A. **Bounded on one side by the Great Plains and on the other by the Western Plateaus, the Rocky Mountains in the United States vary in width from one hundred to nearly four hundred miles.**

B. **The Rocky Mountain region includes western Montana, northern Idaho, central and western Wyoming, northeastern Utah, central and western Colorado, except a small pocket on the Utah boundary, and north central New Mexico.**

II. PHYSIOGRAPHY:

A. **Important Peaks and Ranges: 3036, 842.**

—Canyons 844, 1725.

B. **Continental Divide: 3871, 842, 3818.**

C. **Chief Rivers Rising in the Rocky Mountains:** Missouri 2273; Yellowstone 3830; North and South Platte 1829, 2430, 998; Arkansas 842; Pecos 3476; Rio Grande 3022; Grand 840 (map); Green 3610; Snake 2594; Clark Fork 846.

D. **Lakes and Glaciers: 3035, 1465, 1725.**

E. **Geologic History of the Rocky Mountains:**

a. **Fossils Show They Were Once under the Sea: 1334.**

b. **They are Young Mountains: 2358, 2517, 158** (picture).

c. **Volcanic Formations: 1725.**

III. CLIMATE:

A. **Great Variation in Climate Due to Varying Altitudes: 2310, 1725, 3612.**

B. **Rainfall Ranges from Less than 10 Inches to More than 30 Inches a Year: 3588.**

C. **Atmosphere Dry and Healthful: 3822, 1725, 845.**

IV. NATURAL RESOURCES:

A. **Fertile Valleys: 3820, 2310, 1725.**

B. **Minerals:**

a. **Precious Metals:** Gold 1479, 841, 2309, 1727; Silver 3243, 1727, 2309; Uranium and Radium 2960, 841.

b. **Other Metals:** Copper 882, 2309; Iron 841, 3820; Lead and Zinc 841, 1727, 2309, 2310.

c. **Coal: 841, 2309, 1727, 3820.**

d. **Precious Stones: 2310, 2466.**

e. **Mineral Springs: 1725, 3818, 845.**

C. **Forests: 3035, 2310, 1727, 2466.**

D. **Water Power: 2310, 1725.**

E. **Beautiful Scenery Preserved in National Parks:** Yellowstone Park 3829; Glacier National Park 1466; Rocky Mountain Park 2400; Mesa Verde Park 794 (picture), 844 (text and picture).

V. INDUSTRIES:

A. **Mining:** The references under "Minerals" tell also the story of mining in this region.

B. **Agriculture:**

a. **Field Crops:** Wheat 2310, 1727, 840, 3820; Hay and Alfalfa 1727, 3820, 2310; Potatoes 840, 2310, 3820, 1727; Oats 1727, 840, 3820.

b. **Fruit: 1727, 2310, 840.**

c. **Irrigation Development: 3820.**

C. **Stock Raising: 3820, 1725.**

D. **Lumbering: 2310, 1727, 2466.**

E. **Manufacturing:** The important manufacturing enterprises in the Rocky Mountain Region are mostly all connected with the metal industries. Gold and Copper Smelting are the chief examples 2309, 841.

VI. CHIEF CITIES:

—Butte and Helena 2309, 2312; Colorado Springs 842; Laramie 3822. Both Denver (998) and Cheyenne (3820) are situated on the borderline between the Rocky Mountains and the Great Plains and derive their prosperity from each of these regions.

WESTERN PLATEAUS

BETWEEN the Rocky Mountains and the Pacific Coast Ranges lies a great stretch of broken land, the greater part of which has less than 10 inches of rain a year. The mountains, which almost completely encircle this region, rob the winds of their moisture before they reach this island area, and the summer heat is such that what little rain or underground water finds its way to the surface is rapidly evaporated and blown away. The result is that there are many real deserts in this region. The soil, however, is extraordinarily fertile, and in those districts where irrigation is possible or where the rainfall is somewhat above the average, tremendous crops can be grown. While consisting for the most part of high plateaus, this section of the United States contains also deep basins, in one case—Death Valley—actually reaching below sea level.

I. BOUNDARIES AND AREA:

A. **Stretching from the Mexican border to within less than a hundred miles from the boundary of Canada, the Western Plateaus are in some places as much as 600 miles wide.**

B. **This region includes southeastern Washington, eastern Oregon, southern Idaho, central and eastern Nevada, western and southern Utah, a small area of southwestern Colorado, all of Arizona, a portion of southeastern California, western and southern New Mexico, and the western corner of Texas.**

II. PHYSIOGRAPHY:

A. **General Character of the Surface: 3580.**

a. **Chief Plateaus:** Columbia Plateau in the north and Colorado Plateau to the southeast 3580.

b. **Grand Canyon Cuts through Colorado Plateau: 1495.**

c. **Great Basin:** Lies between the Columbia Plateau, the Colorado Plateau, and the eastern foothills of the Sierra Nevada 3580.

d. **Chief Deserts are Situated in Great Basin:** Great Salt Lake Desert, Black Rock Desert, Mohave Desert, Colorado Desert, Sonoran or Gila Desert 3580; Painted Desert 200; Death Valley 577.

e. **Small Ranges and Isolated Mountains: 200, 2444.**
—The northern spur of the Western Sierra Madres thrusts up from Mexico into Arizona.

f. **Other Physical Features:** Extinct volcanoes and lava formations 200, 1725, 3580.

B. **Rivers and Lakes:** The only important rivers in this region are those which rise in the Rocky Mountains and attain sufficient volume to flow across the arid areas without drying up. The other streams either drain into salt or brackish lakes or disappear quickly in the dry soil 2444.

a. **Rivers which Cross the Basin and Plateaus:** Columbia 845, 2594; Snake 1726, 2594; Colorado 845; Rio Grande 2464, 3022.

b. **Lakes Fed by Interior Drainage:** Great Salt Lake 1515; Humboldt Lake 2445 (map).

III. CLIMATE:

A. **Extremes of Temperature Due to Varying Altitudes and Lack of Tempering Moisture: 199, 2444, 3612, 3686, 2594, 1725.**

B. **Scanty Rainfall: 200, 2444, 1725, 577, 3580.**

C. **Dryness of Atmosphere Makes Climate Healthful: 200, 3612.**

IV. NATURAL RESOURCES:

A. **Minerals are Chief Resource:** Copper, Gold, Silver, and Lead 202, 2444, 2445, 3610, 2466; Nickel, Mercury, Sulphur, and Borax 2445; Salt 2445, 3612; Coal 202, 3612; Zinc 3610; Iron 3612; Building Stone 2445, 3612.

B. **Fertile Soil: 202, 2444, 3610; Forests: 202, 2444.**

V. INDUSTRIES:

A. **Mining and Quarrying:** These are the leading industries of this region. They are described under the references given for "Minerals."

B. **Stock Raising: 202, 2444, 3610, 3687, 2594, 1727.**

C. **Agriculture:** The important farming districts are situated for the most part near the boundaries of the Basin and Plateaus, where water is available for irrigation, or where there is sufficient rain to make possible dry farming methods. While the amount of agricultural land is comparatively small, the yields per acre are enormous.

a. **Chief Crops:** Wheat 3588, 202, 2444, 3610, 3687, 2594, 1726; Barley 202, 2444, 3687, 2594; Oats 3687, 1726; Hay and Alfalfa 202, 2444, 3610, 3687, 2594, 1726; Sugar Beets 202, 3610; Fruits 2444, 3610, 3687; Egyptian Cotton 202, 1830.

b. **Irrigation: 1827, 202, 2444, 3610, 1726, 2465.**

—Roosevelt Dam 1830 (picture); Elephant Butte Dam 2464 (picture); Truckee-Carson System 1829 (picture).

D. **Manufacturing:** With the exception of Smelting, there are few important manufacturing industries in this region 202, 2445.

VI. CHIEF CITIES:

—Salt Lake City 3116; Spokane 3328; Albuquerque and Santa Fe 2466; Tucson 202; Ogden 3612; Boise 1729.

PACIFIC RANGES AND LOWLANDS

NOWHERE in the world is the effect of mountains on climate and the effect of climate upon life better demonstrated than in crossing the great ranges which separate the Western Plateaus and the Great Basin from the Pacific slopes of the United States. On the one side is an arid parched region subject to violent changes of temperature, and, except in small favored localities, bare of useful vegetation, thinly populated, and with few industries. On the other side is a paradise with ample rainfall, equable temperature, luxuriant vegetation, flourishing fields, great cities, and thriving industries. The secret of this tremendous contrast lies in the fact that when the warm moisture-laden winds from the Pacific strike the mountain ranges, they are cooled and release their moisture in the form of rain or mountain snows. The vast Pacific Ocean does not vary much in temperature the year around, so that it remains warmer than the atmosphere in the winter and cooler than the atmosphere in the summer. Thus it prevents extreme variations in temperature along the coast.

I. BOUNDARIES AND AREA:

A. **The Pacific Ranges merge with the Rocky Mountains near the Canadian border. Extending southward they reach their greatest width midway down the coast of the United States, where they are about 250 miles across. At the Mexican border, they merge with the highlands of Lower California.**

B. **This region includes northern and western Washington, western Oregon, some portions of western Nevada, and all of California, except the southeastern corner.**

II. PHYSIOGRAPHY:

A. **Mountain Ranges:**

a. **Sierra Nevada 3231, 576, 2444, 3580; Cascade Range 3686, 2594, 3580; Coast Ranges 3686, 2594, 576, 3580.**

b. **Lesser Ranges and Peaks:** Olympic Mountains 3686, 3580; Mount Whitney 576, 584 (picture); Mount Shasta 3231, 3580; Lassen Peak 3231; Mount Rainier, Mount Baker, Glacier Peak, Mount Adams, Mount St. Helens 3687.

c. **Geologic History:** Form part of young Cordillera Mountains 2517; volcanic formations 3658, 3231; formation of Sierra Nevada and Great Basin 1064.

B. **Chief Valleys:** Puget Trough between Cascades and Coast Range 3581; Great Valley of California between Sierra Nevada and Coast Range 3581, 576, 581.

C. **Chief Rivers:** Columbia 845, 3687, 2594; Willamette 2594; Sacramento and San Joaquin 578, 581.

D. **Coastline:** Because this part of the United States rose from the sea at a comparatively recent geologic period, the coastline is for the most part unbroken and there has not been time for the formation of a coastal plain, such as exists on the Atlantic side. In the north, the coast has sunk again, producing Puget Sound (3687), but southward the coast is still rising, and the only natural harbors are found where the Sacramento-San Joaquin Rivers have cut through the Golden Gate to form San Francisco Bay and where the ocean currents have cut out and built up San Diego Bay (2517).

III. CLIMATE:

—The chief features of the climate of this region are briefly discussed in the opening paragraph of this section.

A. **Mild Equable Temperature: 3686, 2594, 581.**

—Prevailing Westerly Winds 3588.

B. **Rainfall Heavy in the North, Diminishing toward the South, 3686, 577, 3588, 2594.**

IV. NATURAL RESOURCES:

A. **Forests of Tremendously Valuable Timber: 1327, 3687, 2594, 581.**

B. **Minerals:**

a. **Gold, Silver, Copper, Iron, Lead 578, 3688, 2596; Mercury or Quicksilver 578, 582.**

b. **Oil 578; Coal 3688, 2596; Graphite 578.**

c. **Building Stone: 3688, 2596, 578.**

C. **Water Power: 3688, 578.**

D. **Fish:** Salmon 3687–8, 3113; Sturgeon 2596.

E. **Soil:** Very Fertile in Valleys 2596, 578.
F. **Beautiful Scenery Preserved in National Parks:** Yosemite 3831; Mount Rainier National Park 3687; Sequoia National Park 2399–2400.

V. INDUSTRIES:
- A. **Agriculture:**
  - a. **Field Crops:** Wheat, Barley, Alfalfa, Potatoes 578; Rice 582; **Sugar Beets 581.**
  - b. **Fruit:** This is the leading fruit producing region of the United States 1379.
    - 1. Oranges 2588; Lemons 1985; Grapes 1501; Apples 161.
    - 2. Other Fruits: 2596, 3687, 582.
  - c. **Olives and Nuts: 2579, 582.**
- B. **Lumbering and Lumber Products: 3688, 2594, 577, 580.**
- C. **Manufacturing:**
  - a. **Food Products:** Fish Canning 2596; Fruit and Vegetable Canning 580; Flour 3688, 580; Sugar 580; Honey 578; Dried Fruits 582.
  - b. **Iron and Steel Products: 3688.**
- D. **Mining and Quarrying:** Consult the same references as given under "Minerals."
- E. **Motion Picture Industry:** 578, 2344.
- F. **Other Industries:** Oil Refining, Meat Packing 580; Ostrich Farming 578, 2603; Ship Building 3688, 580.
- G. **Transportation:** Shipping centers of the coast carry on trade with Orient 3124, 3169; five transcontinental railroad lines in California 580.

VI. CHIEF CITIES:

—**San Francisco 3124; Seattle 3169; Los Angeles 2062; Portland 2885; Tacoma 3427; San Diego 3123; Sacramento 3103.**

POSSESSIONS OF THE UNITED STATES

THE United States has few colonies or outlying possessions. This is due to the fact that it is the youngest among the great nations of the world, having never suffered from that overcrowding and fierce trade competition which led the nations of Europe to seek foreign territory and the control of distant markets. Much of the earth's surface had been subdivided by European powers before the United States came into existence, and later, when the rush opened for colonies in Africa and in the Pacific, the United States was busy settling and developing its own vast territory. The policy of the government has been generally opposed to acquiring foreign possessions.

I. **ALASKA: 74.**
- A. **Boundaries and Area:** Alaska is bounded on the north by the Arctic Ocean (189–90), on the west by Bering Sea (383), on the south by the Pacific Ocean, and on the east by Canada. Area, 590,884 square miles, making Alaska more than twice as big as the state of Texas.
- B. **Physiography and Climate: 76–7.**
  —Mt. McKinley (2103) is the highest mountain in North America; the Yukon River (3835) with its tributaries provide 3,500 miles of navigable waters.
- C. **Industries:**
  - a. **Mining:** Gold 1479, 3836; Copper 882; Tin 3504; Coal 74.
  - b. **Fisheries:** 1280, 3113.
  - c. **Fur Industry:** Seal fur most important 3167–8.
  - d. **Reindeer Raising: 2993.**

II. **ISLAND POSSESSIONS:**
- A. **In the Atlantic:** For the physiography, climate, and other general characteristics of these islands consult the Outline on the West Indies.
  - a. **Porto Rico: 2885, 3586.**
  - b. **Virgin Islands: 3651, 3586.**
- B. **In the Pacific:** Read the article on the Pacific Ocean (2617) for the general geographic background.
  - a. **Hawaiian Islands: 1601.**
  - b. **Eastern Samoan Islands: 3120; Guam 1545.**
  - c. **Philippine Islands: 2764.**
    —See also general article on East Indies (1070) and Manila (2136).

III. **PANAMA CANAL ZONE: 2648–9, 2651, 3586, 2662 (map).** Apart from its commercial and military importance, the Panama Canal Zone is interesting to the student of Geography because of many peculiar conditions. Under treaty with the Republic of Panama, the United States controls the strip of land in which the canal is built; but since this strip contains the city of Panama, the capital of the Republic, as well as the city of Colon, it has been necessary to leave those portions of land on which these cities stand outside the jurisdiction of the United States. Another interesting feature is the twist in the Isthmus which makes the Atlantic mouth of the Canal actually further *west* than the Pacific mouth (2662).

CANADA

THE British Dominion of Canada, with an area larger than the United States including Alaska, is a much younger country from the point of view of development. The commercial centers on the Atlantic and Pacific coasts, and along the great interior waterways of Canada, present a picture of thriving industry which rivals the prosperity of its sister nation to the south. But in the interior of the Dominion and in the north are vast stretches of wilderness still beckoning to the pioneer and settler. Although the eastern districts of Canada and of the United States were explored and settled at about the same time, Canada did not get started on the road to organized agricultural and industrial development as soon as the United States. This was due to two principal factors: first, the more severe winter climate of Canada which discouraged the pioneer farmer from venturing far from the valley of the St. Lawrence or the tempered regions bordering the Great Lakes; and second, the fact that Canada acquired self-government almost a century later than the United States, lacking meanwhile that coöperation between the provinces and definite home organization so necessary for carrying on great self-supporting enterprises. Since the establishment of the Dominion Government, however, great strides have been made. Except in the extreme north, where the arctic climate makes agriculture impossible, the land is rapidly being brought under the plow. With tremendous natural resources in fertile soil, waterways, water power, forests, minerals, and fisheries, Canada is every year taking a more and more important place in the commerce of the world.

I. **BOUNDARIES AND DIVISIONS:**

A. **Boundaries:** Canada is bounded on the east by the Atlantic Ocean and Baffin Bay, on the north by the Arctic Ocean, on the west by Alaska and the Pacific Ocean, and on the south by the United States. This latter boundary, beginning on the Pacific side, passes south of Vancouver Island through the Strait of Juan de Fuca, thence north to the parallel of latitude 49°, and follows this parallel eastward to the Lake of the Woods. From here it follows a chain of small rivers and lakes to the mouth of the Pigeon River at Lake Superior, crosses this lake, going north of Isle Royal, passes through St. Mary's River, down through Lake Huron, through the St. Clair River, Lake St. Clair, and the Detroit River to Lake Erie, up across Lake Erie, through the Niagara River, across Lake Ontario, and through the St. Lawrence to a point near latitude 45°, thence straight east to the boundary of Maine, and follows the irregular line of this boundary to the Atlantic, emerging at the mouth of the St. Croix River, on the Bay of Fundy.

B. **Political Divisions:**

a. **Maritime Provinces: Nova Scotia 2537; Prince Edward Island 2915; New Brunswick 2449.**
b. **Eastern Provinces: Quebec 2945; Ontario 2582.**
c. **Prairie Provinces: Manitoba 2136; Saskatchewan 3128; Alberta 82.**
d. **Western Province: British Columbia 510.**
e. **Territories: Yukon Territory 3836; Northwest Territories 2528.**
—The Northwest Territories are composed of three Provisional Districts, Keewatin, Mackenzie, and Franklin.

Note: Newfoundland is not a part of the Dominion of Canada but forms an independent British colony. It includes, under its jurisdiction, a narrow strip along the eastern coast of Labrador.

II. **PHYSIOGRAPHY:** The general physiography of the northern part of North America is described in the Outline on pages 3869 to 3873. Here we shall review only those details peculiar to the Canadian region.

A. **Mountains and Plateaus:**

a. **Appalachian Highlands Extend Northward from United States into Maritime Provinces of Canada: 158.**
b. **Laurentian Plateau is Oldest Land Formation in North America: 1970.**
—Covers more than half of Canada: 1970, 602.
c. **Ranges of the Cordillera System in the West:**
—The Canadian Rocky Mountains (3035) and the Coast Ranges (512) inclose a great valley and plateau, which runs parallel with the Pacific coast from the United States boundary to Alaska.

B. **Plains:**

a. **Central Plains of United States Extend over to Tongue of Land between Lakes Huron, Erie, and Ontario: 2582 (see also map of Canada).**
b. **Great Plains Lying Between Laurentian Plateau and Rocky Mountains: 602.**
1. Great Plains include southwestern Manitoba (2136), central and southern Saskatchewan (3128), all of Alberta except a southwestern strip (82), a western strip through the Provisional District of Mackenzie (2528).
2. Plains were once bed of sea (2516) and later bed of great inland lake (2136, 2790).
3. In the extreme north, the Great Plains merge with the Laurentian Plateau to form Barren Lands and Tundras: 603, 2515.

C. **Rivers and Lakes:**

a. **St. Lawrence River Flowing between Appalachian Highlands and Laurentian Plateau: 3107.**
b. **Nelson-Saskatchewan River System Flowing from Rocky Mountains across Great Plains and Laurentian Plateau to Hudson Bay: 604, 3129.**
—Red River of the North: 2986.

- c. **Mackenzie-Athabaska River System Flowing from the Rocky Mountains and the Laurentian Plateau Northward through the Great Plains to the Arctic Ocean: 604, 2102, 82.**
  —Peace River: 2698.
- d. **Yukon River Flowing Northward between the Rocky Mountains and the Coast Ranges and Crossing into Alaska: 3835, 604.**
- e. **Fraser River Flowing Southward between the Mountains and Emptying into Queen Charlotte Sound: 512.**
- f. **Great Lakes: 1510.**
- g. **Other Large Lakes:** Lake Winnipeg 2136; Great Slave Lake and Great Bear Lake 2102.

D. Coastline:
- a. **Deep Fiords and Bays on Coasts of Labrador and British Columbia: 1948, 510.**
  —Caused by sinking of the northern half of North America: 2517.
- b. **Hudson Bay and Northern Island Groups: 1690, 189.**
  —The Magnetic Pole is situated in the southern part of this island group near parallel of latitude 70°: 1064.

E. **Important Islands:** Cape Breton Island 639; Vancouver Island 3617.

III. CLIMATE:

A. **Prevailing Climate is of the "Continental" Type: 606, 794.**
- a. **Great Variation in Temperature: 2136, 512.**
- b. **Extremes of Heat and Cold Tempered by Dryness of Atmosphere: 606, 3128, 2946.**
- c. **Effect of the Chinook Winds: 3751, 82, 2698, 512, 3128.**
- d. **Influence of Great Lakes: 1510, 2582.**

B. Climate of the Atlantic Seaboard:
- a. **Maritime Provinces Have Comparatively Mild Climate: 2915, 2538.**
- b. **Harbors Free from Ice in Winter: 2449.**

C. Climate of the Pacific Coast:
—**Warm Winds from Ocean Keep Winters Mild: 606, 512.**

D. **Climate of the Northern Districts: 2528, 2698, 190.**
- a. **Hudson Bay Ice-Bound Most of the Year: 1690.**
- b. **Long Summer Days Help Make up for Shortness of Warm Season: 2699, 3836.**

E. **Rainfall: 606.**

IV. NATURAL RESOURCES:

A. **Fertile Soil: 602, 2136, 2698, 1970, 2946, 83.**
- a. **Vast Districts Still Uncultivated: 602, 608, 512.**
- b. **Good Grazing Land: 512.**

B. **Vast Forests of Valuable Timber: 610.** Forests, composed chiefly of evergreen trees, cover almost all of the uncultivated surface of Canada, except the Great Plains and the Arctic Regions.
- a. **Forests on the Laurentian Plateau: 1970, 2945, 1690, 2583, 2137, 3128.**
- b. **Forests of the Rocky Mountains and West Coast: 512, 607 (picture).**
- c. **Forests in the Maritime Provinces: 2538, 2449, 606 (picture).**

C. **Minerals: 610, 1970.**
- a. **Gold and Silver: 512, 2582, 2583, 3836, 2137, 3242.**
- b. **Sudbury District of Ontario Produces Most of the World's Nickel: 2507, 610, 2582, 2583 (picture).**
- c. **Most of the World's Asbestos Comes from Quebec: 225, 610, 2945, 2946 (picture).**
- d. **Coal and Petroleum: 610, 640, 512, 82, 2538, 3128, 2583.**
- e. **Other Minerals:** Copper 512, 2137, 2583, 2945, 3836; Iron 610, 512, 2538, 2583, 2945; Zinc and Lead 512, 2583; Cobalt 816, 610; Mica, Molybdenite, and Graphite 2945.

D. **Fish: 610, 512, 2137, 1285.**

E. **Fur-Bearing Animals: 1389, 603, 2137, 2528, 2583.**

F. **Vast Network of Waterways and Unlimited Sources of Water Power: 603-6, 2582, 2947, 512, 3694, 2604, 3835.**
—The Great Lakes and the St. Lawrence River form one of the most important systems of water transportation in the world: 1510, 3107.

G. **Beautiful Scenery Preserved in National Parks: 2400.**

V. INDUSTRIES:

A. **Agriculture the Most Important Industry: 606, 608, 2136, 82.**
- a. **Wheat is the Largest Crop: 602, 3128, 2137, 2582, 3732.**
- b. **Other Crops:** Oats 608, 2582, 3128, 2915; Barley 2582, 3128; Rye 3128; Flax 2582, 3128; Hay 2449, 2582; Potatoes 2449, 3128, 2915.
- c. **Fruit: 608, 512, 2538, 2582, 2946.**
- d. **Irrigation and Dry Farming: 3128, 82, 512.**

B. **Stock Raising, Dairying, and Dairy Products: 608, 2137, 3128, 2449, 2582, 2915, 2946.**

C. **Mining:** Only a small part of Canada's vast mineral resources have been developed 610; see also references under Minerals.

D. **Lumber and Lumber Products: 610, 2945, 2583, 3128, 512, 2538, 2449.**
—Wood Pulp for making Paper (2667) is an important product: 2583, 2449, 640, 2946 (picture).

- E. **Fisheries: 610, 2538, 2449, 2915, 2137.**
  - a. **Salmon Canning in British Columbia: 512.**
  - b. **Canada's Department of Fisheries: 1280.**
- F. **Fur Industry: 1389.**
  - a. **The Famous Hudson's Bay Company: 1692.**
  - b. **Fur-Farming in the Maritime Provinces: 610, 2915, 1389.**
- G. **Manufacturing: 610.** The most important manufacturing region in Canada is southern Ontario: 2582. For the various products of Canadian factories consult also the city articles listed at the end of this Outline.

VI. TRANSPORTATION:

- A. **Water Transportation:** In addition to the natural waterways referred to under Natural Resources, numerous canals facilitate commerce in the Dominion. Chief among these are the Welland Canal, the Trent Canal, the Rideau-Ottawa Canal system, the Rideau Canal (3716, 627).
- B. **Importance of Railroads to Development: 608, 2449, 513, 3617.**

VII. CHIEF CITIES:

- A. **Seaports: Halifax 1565; Saint John 3107; Vancouver 3617; Victoria 3638.**
- B. **River Ports: Montreal 2317; Quebec 2948; Ottawa (capital) 2604.**
- C. **Lake Ports: Toronto 3516; Kingston 1926; Hamilton 1569; Fort William 1333.**
- D. **Interior Cities: Winnipeg 3752; Regina 2992; London 2057; Edmonton 1084; Calgary 575.**

Newfoundland and Labrador

ALTHOUGH the island of Newfoundland is closely related in the geographical sense to the Canadian mainland, it has a colonial government entirely independent of the Dominion. It is regarded as the senior colony of the British Empire, the original claims to the island having been based upon the discoveries of John Cabot in 1497. Because of the important position of the Labrador coast in connection with the great fisheries of this region, this coast was placed in 1763 under the Newfoundland governorship. Today, a strip running from Hudson Strait to the Strait of Belle Isle remains a part of this colony.

I. POSITION AND PHYSIOGRAPHY:

- A. **Newfoundland Occupies Strategic Position at Mouth of Gulf of St. Lawrence: 2450.** It is separated from the northern mainland by Belle Isle Strait, and from Cape Breton Island by Cabot Strait. South of Newfoundland lie the two small islands of St. Pierre and Miquelon which belong to France.
- B. **Newfoundland is a Rugged Rock-Bound Island: 2450.**
  - a. **Highlands in the West:** These are geologically a continuation of the Appalachian Highlands which run through the Maritime Provinces of Canada.
  - b. **Soil in the East Deposited by Melting Icebergs: 2450.**
- C. **Fiords and Bays of Labrador Caused by Sinking Coastline: 2517, 1948.**

II. CLIMATE:

- A. **Eastern Newfoundland Cold and Foggy: Western Newfoundland Has Milder Climate: 2450, 1316.**
- B. **Labrador a Lonely Land of Brief Summers and Frigid Winters: 1948.**
  —Effect of the Labrador Current: 1948, 255.

III. NATURAL RESOURCES AND INDUSTRIES:

- A. **Newfoundland Banks and Labrador Coast Famous for Their Fish: 2450, 1948.**
  - a. **Cod the Most Important Product of the Fisheries: 1282–4.**
  - b. **Other Products of Fisheries:** Salmon, Seal Oil, Whalebone, Herring 1948.
- B. **Coal, Petroleum, Copper, Iron, and Timber: 1948, 2450.**
- C. **Fur Industry in Labrador: 1948.**
- D. **Some Manufacturing in Newfoundland:** Paper and Pulp Mills, Ship-Building 2450.
- E. **Water-Power at Hamilton Inlet, Labrador: 1948.**

IV. POPULATION:

- A. **Newfoundland Settled by English, Scotch, and French Fishermen: 2450.**
- B. **Cree Indians and Eskimos Mingle with White Settlers in Labrador: 1948, 1174.**
- C. **St. Johns, the Capital of the Colony, is the only Important City: 2450.**

MEXICO

MEXICO is a land of enormous natural wealth. Almost every resource essential to modern industry exists in profusion. Yet this great land is economically poor. Its resources lie for the most part undeveloped. Agriculture is backward, railroads are comparatively few and often poorly equipped, and internal commerce as well as foreign trade are for the most part unorganized. For the causes of this condition we must look back into history. Mexico was conquered and brought under European influences long before the rest of North America. When the Pilgrims landed at Plymouth Rock, Mexico was already under the dominion of a powerful colonial organization.

But the Spanish conquerors were not trying to create prosperity in Mexico, nor did they work to establish permanent self-supporting settlements, nor to develop agriculture and trade. For them Mexico was simply a great mine of gold and silver, a storehouse of rare woods and spices, to be exploited and drained of its superficial and easily-obtained wealth for the benefit of the royal government and its favored representatives. To carry out this plan of exploitation, the natives were virtually enslaved and set to work for the conquerors. Three hundred years this condition lasted, and when Mexico finally won its independence, it had a population untrained in government or individual industry, and sharply divided into a small educated class and a large ignorant class. The result was political chaos. Revolution followed revolution. Ambitious leaders always found it easy to recruit bands of lawless followers from the uneducated masses. Order prevailed only when some leader more powerful than the rest succeeded in establishing a dictatorship, which drove the peon unwillingly back to his toil.

Today, however, a new era is dawning for Mexico. The national consciousness is aroused to the fact that any sound economic system in that great land can be built only with the aid of an educated public. With the friendly aid of foreign governments, Mexico bids fair to come into its own.

I. BOUNDARIES AND AREA:

- A. **The Rio Grande marks the boundary between the United States and Mexico from the Gulf of Mexico to the westernmost point of Texas. From there the boundary runs westward with a few small breaks, emerging on the Pacific coast a few miles below San Diego Bay. At the other end Mexico borders on Guatemala and British Honduras.**
- B. **The general shape of the country is a rough triangle slanting from northwest to southeast. The southern tip of the triangle curves upward in the Yucatan Peninsula, which forms the Gulf of Campeche, and, with the aid of Florida and Cuba, encloses the Gulf of Mexico. At the other extremity of the triangle, the peninsula of Lower California juts southward into the Pacific, forming the Gulf of California. The Tropic of Cancer cuts Mexico in two.**

II. PHYSIOGRAPHY:

- A. **Mountains and Plateaus:** The mountains of Mexico form part of the great Cordillera system 2515.
  - a. **Divided into Two Principal Ranges:**
    - 1. Sierra Madre Oriental or Eastern Sierra Madre: 2209.
    - 2. Sierra Madre Occidental or Western Sierra Madre: 2209.
  - b. **Central Mexican Plateau or Table Land between the Two Ranges: 2209.** This is part of the great North American Plateau which runs from Alaska south to Mexico City: 2515.
  - c. **Cordillera Mountain Chain Broken at Isthmus of Tehuantepec: 2515.**
  - d. **Many Active and Extinct Volcanoes: 2515, 2209.**
- B. **Coastal Plains:**
  - a. **Eastern Coastal Plain is an Extension of the Gulf Coastal Plain of the United States: 3581.** This plain broadens out in the south to cover most of the Yucatan Peninsula (3834). The coast is low and has no good natural harbors (2209).
  - b. **Western Coastal Plain is Narrow: 2209 (map).** Many fine harbors are found on the west coast (2209).
- C. **Two Great Peninsulas: Yucatan 3834; Lower California 587.**
- D. **Rivers:** With the exception of the Rio Grande (3022), the rivers of Mexico are of no great size. The mountain ranges are too close to the coasts to allow large streams to form 2208 (table), 2209 (map).

III. CLIMATE:

- A. **Temperature Varies Greatly with Altitude: 2210.** Coastal plains exceedingly hot; Central Plateau mild; mountains cold.
- B. **Yucatan and Lower California Generally Hot and Dry: 3834, 587.**
- C. **Rainfall:** Heavy rains in the south, but mountains cut off moisture from interior 2210.

IV. NATURAL RESOURCES:

- A. **Rich Soil and Extensive Grazing Lands: 2208, 2212.**
- B. **Minerals:**
  - a. **Anthracite Coal in Sonora: 2208, 2211; Graphite 2210.**
  - b. **Metals:** Silver 2208, 2210; Gold, Copper, Lead, Iron, Antimony, Quicksilver, Zinc, Manganese 2210.
  - c. **Vast Supplies of Oil: 2211, 2753, 2749 (picture).**
- C. **Great Forests of Valuable Timber: 2208, 2213–4, 2046.**

V. INDUSTRIES:

- A. **Agriculture:** The great variety of climate in Mexico makes it possible to raise almost every kind of crop 2208.
  - a. **Chief Food Crops:** Corn, Wheat, Beans, Sugar Cane, Coffee, Cacao, Fruits, and Spices 2213.
  - b. **Fiber Crops:** Cotton 2213, 3834; Agave or Sisal Plant 42, 3244, 2214, 3834.
  - c. **Other Crops:** Tobacco 2213; Guayule Rubber 2212, 3074.
- B. **Stock Raising on the Northern Plateaus: 2212.**
- C. **Mining is the Principal Industry:** Mexico produces one third of the world's Silver, ranks next to the United States in Copper production, and yields important quantities of Lead, Zinc, Antimony, and Graphite. The Coal and Iron deposits have not yet been developed on an important scale. See also references under Minerals above.
- D. **Mexico Ranks Next to United States in Oil Production: 2211.**
- E. **Manufacturing:** Meat Packing, Cotton Milling, Rope and Twine, Soap, Cigars and Cigarettes, Sugar, Rubber 2212–3.

F. **Foreign Trade:** Mexico's foreign trade is mostly with the United States. Exports consist chiefly of Mineral Products, Sisal, Cotton, Tobacco Products, and Cattle.

VI. CHIEF CITIES:
—**Mexico City 2218; Guadalajara 2209 (map); Vera Cruz 3626.**

VII. PEOPLES OF MEXICO:
- A. **Original Inhabitants: Aztecs and Mayas 288, 3834.**
- B. **Invasion by Spaniards in 16th Century: 894.**
- C. **Present Mixed Population of Indian and White Blood: 2208.**

CENTRAL AMERICA AND WEST INDIES

THE continents of North and South America may be said to be connected by two sets of mountain chains. One of these, which is above sea level throughout its entire length, forms the great isthmus which we call Central America. The other is partially submerged beneath the waters of the ocean, leaving only its loftiest peaks and plateaus exposed. These form the great chain of islands known as the West Indies or Antilles. A glance at the map on page 110 will show you the relationships of these land masses. The Yucatan Peninsula and the Florida Peninsula, which form the Gulf of Mexico, are both continued in that island chain which sweeps eastward and then southward in a giant curve reaching to the coast of Venezuela in South America, and embracing the Caribbean Sea. All of Central America and all of the West Indies, except a few small islands to the north, lie in the Tropical Zone. This circumstance as well as their geological formation gives the two many things in common.

Central America

I. BOUNDARIES AND AREA: **679, 680** (map).
- A. **The name Central America is applied to the great isthmus which stretches from the Yucatan Peninsula southeastward to the mainland of South America. Geographically, it is usually considered a part of North America, although its climate, its plant and animal life, and its people have more in common with tropical South America.**
- B. **The total area of Central America is somewhat more than the combined areas of the New England States, New York, New Jersey, Pennsylvania, and Ohio.**

II. PHYSIOGRAPHY AND CLIMATE:
- A. **Backbone of Mountains Belonging to Cordillera Chain: 2515, 679.** Chain broken by lake basin of Nicaragua: 2504.
- B. **A Land of Volcanoes and Earthquakes: 679, 3119, 2504, 1546.**
- C. **Two Contrasting Regions:**
  - a. **Atlantic or Caribbean Coastal Region:** Generally low and swampy, hot, and unhealthful, 679, 1546, 2505.
  - b. **Mountainous Region on Pacific Side:** Temperate and generally healthful, 679, 1547, 2505.

III. PLANT AND ANIMAL LIFE:
- A. **Hot Lowlands:** Dense vegetation, inhabited by countless animals similar to those found in the tropical forests of South America: 680.
- B. **Upland Valleys:** Vegetation more nearly resembling that of the Mexican plateau: 2505, 1676.

IV. PEOPLE OF CENTRAL AMERICA:
- A. **Population Made up of Three Principal Elements:** Spanish, Indian, and Negro. These have largely intermingled, particularly in the more settled regions: 679, 1546, 1676, 3119, 2505, 896.
- B. **People Chiefly Center in Settlements on Pacific Coast Side: 2505, 1676.**

V. PRODUCTS:
- A. **Hot Lowland Region: 680.** Bananas 324, 325 (picture), 896, Mahogany 2124, Logwood 2046, Chicle 719, Guayule Rubber 3074, Coconuts 2649.
- B. **Upland Region: 679.** Coffee 822, 679, Tobacco 2649, Cacao, Corn, Rice, Beans, Sugar 2505, Henequen 1676, Gold and Silver 679, Copper, Iron, and Coal 1676.

VI. TRADE AND TRANSPORTATION:
- A. **Foreign Commerce: 2505, 896, 1546, 1676, 3118.** Trade mostly with United States 680.
- B. **Few Railways, Transportation Mostly by Highways: 679, 896** (picture).

VII. POLITICAL DIVISIONS:
- A. **Guatemala: 1545.** Area, 48,290 square miles; population, about 2,000,000. Chief cities: Guatemala City (capital); Atlantic Coast port, Puerto Barrios; Pacific Coast port, San Jose.
- B. **Honduras: 1676.** Area, 44,275 square miles; population, about 775,000. Chief cities: Tegucigalpa (capital); Atlantic coast port, Puerto Cortes; Pacific Coast port, Amapala.
- C. **Salvador: 3118.** Area, 13,150 square miles; population, about 1,300,000. Chief cities: San Salvador (capital), Santa Ana; no Atlantic coast line; Pacific Coast ports, Acajutla and La Union.
- D. **Nicaragua: 2504.** Area, 49,200 square miles; population, about 750,000. Chief cities: Managua (capital), Leon, Granada; Atlantic Coast port, Bluefields; Pacific Coast ports, Corinto, San Juan del Sur.
- E. **Costa Rica: 896.** Area, 23,000 square miles; population, about 500,000. Chief cities: San Jose (capital), Cartago; Atlantic Coast port, Limon; Pacific Coast port, Puntarenas.

F. Panama: 2648. Area, 32,380 square miles; population, about 450,000. Chief cities: Panama (capital and Pacific Coast port); Atlantic Coast port, Colon.

G. Foreign Territory:

- **a. British Honduras: 1676.** Area, 8,600 square miles; population, about 45,000; capital, Belize.
- **b. Panama Canal Zone (United States): 2651, 2662 (map).**

West Indies

I. POSITION AND AREA: 3718, Map next to page 2515.

A. The West Indies stretch from the entrance to the Gulf of Mexico eastward and southward to the coast of South America, forming the northern and eastern boundary of the Caribbean Sea. With the exception of a part of the Bahamas, they lie entirely within the tropical zone. The Bahamas reach within 60 miles of the Florida coast.

B. The total area of the West Indies, including islets and keys, is approximately 92,000 square miles, about the same as the combined area of Indiana and Illinois.

II. PHYSIOGRAPHY AND CLIMATE:

A. Bahamas Consist of Coral Formations Resting on Submerged Mountains: 3718, 305.

B. Remainder of West Indies Chiefly of Volcanic Formation: 3718, 2156.

- **a. Most of the Islands have Important Mountains, Sometimes Snow-Capped: 936, 1859, 1560, 3125, 2885, 2156, 3541.**
- **b. Mont Pelée, an Active Volcano: 2156.**
  - —Earthquakes are frequent: 1859, 1545.

C. Rolling Plains on Some Islands and Low Swampy Coast Lands: 936, 3126, 3541.

D. Usually Hot and Damp with Abundant Rainfall: 936, 2886, 2156, 1560.

E. Hurricanes are Frequent: 936, 1859, 1545.

III. PEOPLE OF THE WEST INDIES:

A. Majority of People of Entire West Indies are Negroes or of Negro Descent, Though Whites Predominate in Some Islands: 3718, 937, 1860, 1561, 3126, 2886, 305, 3651, 329, 3541.

B. Whites are of Mixed Nationalities in All the Islands, Including Descendants of Early Spanish Conquerors: 3718, 987, 2886.

C. Negroes are Descendants of Former Slaves: 937, 1860, 1561, 2434.

D. East Indians and Chinese Introduced as Laborers: 3718, 1860.

IV. PRODUCTS:

A. Cane Sugar, Tobacco, Fruits, Cotton, and Coffee are the Chief Products: 3385, 3509, 2011, 904, 822, 936, 1859, 2885-6, 1561, 3126, 1545, 3541.

— **Typical Fruits:** Bananas, Pineapples, Oranges, Lemons, Grapefruit, Mangoes, Guavas and Alligator Pears.

B. Rare Woods: Mahogany, Lignum Vitae, Ebony, Rosewood, Logwood, and Satinwood 3718, 936, 1859, 1561, 3126, 2886, 1073, 2046.

C. Live Stock: 936, 2886.

D. Other Products: Cocoa 1561, 1545, 2156, 3541; Spices 1859, 1545; Sponges and Sisal 305; Asphalt 3541; Guano and Phosphate Rock 2886.

E. Metals: The deposits of Iron, Manganese, Copper, Gold, and Silver in the islands have not been developed 936, 1560, 3126, 2886.

V. DIVISIONS OF WEST INDIES: The West Indies fall into three great natural groups: (1) the **Bahamas;** (2) the **Greater Antilles,** including Cuba, Jamaica, Haiti, and Porto Rico; and (3) the **Lesser Antilles,** including the Leeward Islands, the Windward Islands, Barbados, Trinidad and Tobago, and the chain of small islands off the north coast of South America, the most important of which form the Curaçao group.

A. Bahamas: 305 (British). Comprise more than 3,000 islands; area, about 4,400 square miles; population, about 60,000. Capital and chief city, **Nassau.** Principal islands: New Providence, Grand Bahama, Abaco, Eleuthera, Andros, Exuma, Cat, Watling or San Salvador, Acklin, and Great Inagua. The Turks and Caicos Islands belong geographically to the Bahamas, but are under the government of Jamaica.

B. Cuba: 936 (Independent). Area, including Isle of Pines, 44,200 square miles; population, about 3,375,000. Chief Cities: **Havana** (capital), **Camaguey, Cienfuegos, Santiago de Cuba, Guantanamo, Santa Clara, Matanzas,** and **Manzanillo.**

C. Jamaica: 1859 (British). Area, about 4,200 square miles; population, about 900,000. Capital and chief city, **Kingston.** Area of Turks and Caicos Islands (see Bahama), 224 square miles; population, about 5,500; Cayman Islands, about 100 square miles; population, about 5,500.

D. Haiti: 1560. This island is divided politically into two parts:

- **a. Republic of Haiti: 1560.** Area, about 10,200 square miles; population, about 2,500,000. Capital and chief city, **Port-au-Prince.**
- **b. Republic of Santo Domingo: 3125.** Area, about 19,000 square miles; population, about 955,000. Capital and chief city, **Santo Domingo.**

E. Porto Rico: 2885 (United States). Area, about 3,600 square miles; population, about 1,300,000. Capital and chief city, **San Juan.**

- **F. Leeward Islands** (United States): Consisting of part of **Virgin Islands (3651)**; area, 132 square miles; population, 26,000. Principal islands: St. Croix, St. Thomas, and St. John. Chief City, **St. Thomas** (formerly Charlotte Amalie).
- **G. British Leeward Islands:** Area, 715 square miles; population, about 127,000. Principal islands: British Virgin Islands (3651), comprising Tortola, Virgin Gorda, Anegada, Jost-VanDykes and about 30 smaller islands; St. Kitts, Nevis and Anguilla; Antigua, Barbuda, and Redonda; Montserrat; and Dominica. Chief city, **St. John** on Antigua Island.
- **H. French Leeward Islands:** Area, 688 square miles; population, about 215,000. Principal islands: **Guadeloupe (1545)** and Marie Galante. Chief cities, **Basse-Terre** (capital) and **Pointe-à-Pitre.** Under the Guadeloupe government is included one half the island of St. Martin, the other half, with St. Eustache (or Eustatius), belonging to the Dutch colony of Curaçao (see below).
- **I. Windward Islands:**
    - **a. Martinique: 2156** (French). Area, 385 square miles; population, about 245,000. Capital and chief city, **Fort de France.**
    - **b. British Windward Islands:** Area, about 530 square miles; population, about 190,000. Principal Islands: St. Lucia, St. Vincent, Grenada, and the Grenadines, Chief cities, **St. George, Castries,** and **Kingstown.**
- **J. Barbados: 329** (British). Area, 166 square miles; population, about 200,000. Capital and chief city, **Bridgetown.**
- **K. Trinidad and Tobago: 3541** (British). Area of Trinidad, 1860 square miles, of Tobago, 114 square miles; joint population, about 385,000. Chief cities, **Port of Spain** (capital) and **Scarborough.**
- **L. Curaçao Group:** (Dutch). Area, 403 square miles; population, about 55,600. Principal islands: Curaçao Bonaire, and Aruba. Capital and chief city, **Willemstad.** The government of Curaçao extends to the Dutch possessions in the Leeward Islands—St. Eustache and one half of St. Martin.

SOUTH AMERICA

SOUTH AMERICA is today the continent of opportunities. Endowed with unlimited natural resources, every variety of climate and land formation, rich mineral deposits, great rivers, vast forests, and fertile plains, the southern half of the New World can look forward to a future of ever-increasing prosperity and power. In the past it has suffered from the same unfortunate heritage as Mexico and Central America, the heritage of ruthless conquest and exploitation by the first European colonizers. The new nations which sprang up from the ashes of foreign misrule have suffered from internal disorders and the blights of war. Vast wealth in the hands of the few has too often been dissipated in fomenting political plots and revolutions, and the natural resources of this favored continent have frequently been sold by unscrupulous leaders to foreigners who have drawn away the profits of their enterprises to other lands. Today, however, the South American nations have for the most part begun to build on a solid foundation, developing their own resources with the constructive aid of foreign capital, and looking after the education of their people. Many South American cities rank as the most progressive centers in the world, not only in such things as engineering, sanitation, schools, and transportation, but also in fostering the higher arts and general education.

I. PHYSIOGRAPHY:

- **A. Comparison with North America: 3284.**
- **B. Mountains and Highlands:** See map opposite page 3288.
    - **a. Andes, extending along the West Coast from Isthmus of Panama to Cape Horn: 122.**
        - **1.** Part of "world ridge" which in North and South America is known as the Cordillera System: 2515, 122.
        - **2.** Longest of all mountain chains and surpassed in height only by Himalayas: 123, 3284. —Aconcagua is the highest peak 10; other peaks 123.
        - **3.** Andes are young, growing mountains as shown by presence of active volcanoes and frequent earthquakes: 3284, 123.
    - **b. Brazilian Highlands or Table-Land in the East: 3284, 494.** —Old and worn-down mountain system like the Appalachians of North America.
    - **c. Guiana Highlands and Plateau in the North: 1546, 3620.**
- **C. Plains:** About two-thirds of South America consists of lowland plains which are divided about equally into forest lands and grasslands. Near the Andes are strips of desert or semi-desert lands.
    - **a. Amazon Lowland, the Largest River Basin in the World: 105, 493.** —Covered with a dense tropical forest: 105, 3284.
    - **b. Guiana Lowlands and Coastal Plain: 1546.**
    - **c. Temperate Zone Forests Cover Portions of South Central Plains such as the Gran Chaco: 190, 2676.**
    - **d. Treeless Grasslands:**
        - **1.** Llanos of Colombia and Venezuela: 836, 3620, 2600.
        - **2.** Grasslands of Southern Brazil, Paraguay, and Uruguay: 494, 2676, 3608.
        - **3.** Pampas of Argentina: 190–1, 3285.
        - **4.** Savannas of Guiana: 1546.

- **D. Rivers and Lakes of South America:** All the important rivers of South America empty into the Atlantic Ocean. The Andes crowd the Pacific coast so closely that there is no opportunity for large rivers to form on that side of the mountains.
  - **a. Magdalena River in the Extreme North with Its Chief Tributary, the Cauca: 836.**
  - **b. Orinoco River: 2600.**
  - **c. Amazon River with More Than 200 Tributaries: 105.**
  - **d. Tocantins and Sao Francisco Rivers, Both Rising in the Brazilian Highlands: 494.**
  - **e. Plata River Formed by the Junction of the Uruguay and Parana Rivers: 2831.**
  - **f. Rio Negro Forming the Northern Boundary of Patagonia: 2692.**
  - **g. Lake Titicaca Largest Lake in South America: 449, 2742 (picture).**
- **E. Coastline:**
  - **a. Coastline is Regular with No Large Projections, Peninsulas, or Bays such as Those of North America: 3286.**
  - **b. Southern Coast of Chile Marked by Jagged Fiords and Chain of Coastal Islands: 3286.**

Note: Just as the land mass of North America is slowly sinking in the north and rising from the sea in the south, so South America is slowly rising in the north and sinking in the south. This accounts for the broken coastlines at the opposite extremities of each continent and the smooth even coasts of southern North America and northern South America.

- **F. Chief Islands Near South America:**
  - **a. Tierra del Fuego Group at the Southern Tip Separated from Mainland by Magellan Strait: 3285, 735, 123.**
  - **b. Trinidad and Falkland Islands (British): 3541, 1223.**
  - **c. Juan Fernandez Islands: 737, 933.**
  - **d. Galapagos Islands: 1079.**

II. CLIMATE:

- **A. Intensely Hot and Damp in Tropical Lowlands and Coastal Plains: 494, 3622, 835, 1079, 1546.**
  - **a. Altitude of Tropical Highlands Gives Them Temperate Climate: 3622, 835, 1078, 449, 122.**
  - **b. Snow and Intense Cold in Tropical Mountains: 3285, 449.**
- **B. Climate of Temperate Zone to the South Resembles that of United States and Canada: 191, 736, 3608.**
- **C. Rainfall:** See Rainfall Map opposite page 3288, and on page 2973.
  - **a. Tropical Lowlands East of Andes have Heavy Rainfall: 2972, 494, 190–1.**
  - **b. Prevailing Easterly Winds in Tropical North Deposit Their Moisture on Eastern Slopes of Andes, Leaving Most of West Coast Arid: 2741, 122.**
    —Modifying effects of the Antarctic current: 1078.
  - **c. Prevailing Westerly Winds in Temperate South Deposit Moisture on Pacific Side of Andes, Leaving Interior Mountain Slopes and Plains Arid: 122–3, 191.**
  - **d. Tremendous Rainfall in the Extreme South: 735–6.**
- **D. Seasons:** It must be borne in mind that below the Equator in South America, the Seasons are the reverse of those in the Northern Hemisphere, so that January and February are the mid-Summer months, while July and August are the mid-Winter months: 3285.

III. MINERAL RESOURCES OF SOUTH AMERICA: **3289.**

- **A. In Northern Andes:** Amethysts and Emeralds, Platinum, Gold, Silver, Quicksilver or Mercury, Copper, Lead, Zinc, Magnesium, Antimony, Iron, Coal, Petroleum and Asphalt: 836, 1079, 2742.
- **B. In Central Andes:** Gold, Silver, Tin, Nickel, Copper, Tungsten, Lead, Iron, Manganese, Antimony, Bismuth, Sulphur, Coal, Gypsum, Borax, and Nitrates: 450, 736, 192, 3289.
- **C. In Southern Andes:** This part of the mountains is much poorer in minerals than the northern regions, and there has been virtually no development of mineral resources except coal (3289).
- **D. In Guiana Highlands:** Gold, Aluminum, Copper, Iron, Coal, Petroleum, and Asphalt 1546, 3622.
- **E. In Brazilian Highlands:** Diamonds, Iron, and Gold are most important; others are Platinum, Thorium, Silver, Copper, Lead, Mercury, Manganese, Coal, and Graphite 3289, 494.

IV. VEGETATION AND ANIMAL LIFE: **836, 1546, 1079, 493, 2742, 450, 2677, 736, 191, 106**

- **A. Typical South American Plants:**
  - **a. Native Plants:** Quebracho 2677; Brazilwood 3284; Rubber Trees 3072–3; Ivory Palm 549; Araucarian Pine 3533; Cinchona 2950; Sarsaparilla 3127; Indigo 1777; Tolu Balsam 2728; Fustic or Dye Wood 1050; Bamboo 323; Cacao 562; Coca 2742; Maté 3286 (picture); Orchids 2593; Giant Water-Lilies 3699; Cotton 904–5; Potato 2900; Tomato 3513; Tobacco 3510; Pineapple 2809.
  - **b. Plants introduced by Whites:** Coffee 822; Sugar Cane 3385; Oranges 2588; Bananas 324.
- **B. Typical South American Animals:** Monkeys 2289–90 (text and pictures); Jaguar 1859; Puma 2933; Tapir 3434; Llama and Guanaco 2039; Alpaca and Vicuna 100; Pudu or Dwarf Deer, Pampas Deer, and Guemal 981; Peccary 2706; Chinchilla 752; Sloth 3252; Armadillo 211; Ant-Eater 145; Vampire Bat 346; Manatee or Sea Cow 2134; Opossum 2585; Rhea 2603; Condor 856; Toucan 3520; Hoatzin 401 (pictures); Parrots and Macaws 2690; White Ibis 3364; Flamingo 1289; Alligator 98; Matamata Turtle 3563; Iguana and Teguexin 2036; Boa Constrictor and Anaconda 440.

V MANKIND IN SOUTH AMERICA:

- **A. Discovery, Exploration, and Conquest: See map page 110.**
  - **a. Columbus in 1498 Reaches South America: 3289, 849.**
  - **b. Americus Vespucius and His Claims to Discovery: 3634.**

c. In 1500 Vicente Pinzon Discovers Brazil for Spain, but Pedro Cabral Takes Possession for Portugal: 496.

d. Juan de Solis in 1515 Visits Argentina Coast: 192, 109.

e. Magellan in 1520 Sails Around South America: 2115.

f. Sebastian Cabot in 1526–7 Explores Plata River Region: 192, 562.

g. Francisco Pizarro in 1530 Begins Conquest of Peru (including Bolivia): 2814.

h. Pizarro's Men in 1534 Conquer Ecuador: 1079.

i. In 1535 Spaniards Invade Chile: 738.

j. In the same year Juan de Ayolas Founds Asuncion in Paraguay: 2677.

k. Conquest and Colonization of New Grenada (Colombia): 836.

l. Sir Francis Drake's Famous Voyage along the West Coast: 1030.

m. Sir Walter Raleigh's Fruitless Expeditions: 2975–6, 1547.

B. Peoples of South America:

a. Traces of Prehistoric Peoples:

1. Ruins of Tiahuanaco in Bolivia: 449.

2. Remains of Ancient Civilization in Ecuador: 1078.

b. The Great Empire of the Incas: 1741.

c. Indian Types in South America Today: 3869.

d. White and Mixed Population:

1. Whites Mostly of Spanish and Portuguese Blood: 3286–8, 495.

2. Mestizos of Mixed Indian and European Stock Form Majority of Population: 3288, 3622.

3. Negro Element Important in Brazil: 2434, 495.

e. No Race Prejudice in South America: 3288.

C. Distribution of Population: See map opposite page 3288. Notice how the centers of densest population are still on or near the sea coast, while the vast interior has, for the most part, less than three people to the square mile.

Countries of South America

I. COLOMBIA: 835.

A. Boundaries and Chief Physical Features: Colombia is bounded on the north by the Caribbean Sea, on the west by the Isthmus of Panama and the Pacific Ocean, on the east by Venezuela and Brazil, and on the south by Ecuador and Peru. The northwestern half consists of Andes Mountain ranges and a small coastal plain on the Gulf of Darien; the southeastern half forms part of the Orinoco and Amazon River basins.

B. Area, about 440,000 square miles; Population, over 6,600,000.

C. Chief Products: Coffee, Sugar, Cocoa, Bananas, Cotton, Hides, Platinum, Gold, and Emeralds.

D. Chief Cities: Bogota (capital), Barranquilla, and Cartagena.

II. VENEZUELA: 3620.

A. Boundaries and Chief Physical Features: Venezuela is bounded on the north by the Caribbean Sea, on the east by the Atlantic Ocean and Guiana, on the west by Colombia and on the south by Brazil. A great northeastern spur of the Andes crosses Venezuela, separating the basin around Lake Maracaibo (3621) and the Gulf of Venezuela from the Orinoco Lowlands. To the south of the Orinoco River, which cuts the country into two almost equal parts, lie the Guiana Highlands.

B. Area, about 394,000 square miles; Population, about 3,000,000.

C. Chief Products: Coffee, Cocoa, Sugar, Hides, Petroleum, and Gold.

D. Chief Cities: Caracas (capital), Valencia, and Maracaibo.

III. BRAZIL: 493.

A. Boundaries and Chief Physical Features: Brazil is bounded on the north by the Atlantic Ocean, Guiana, and Venezuela, on the east by the Atlantic Ocean, on the west by Colombia, Peru, and Bolivia, and on the southwest and south by Paraguay, Argentina, and Uruguay. The vast basin of the Amazon (105) occupies the northern, central, and western parts of Brazil. The southern and eastern parts contain the Brazilian Highlands, and the upper valleys of the Paraguay and Parana Rivers.

B. Area, about 3,292,000 square miles; Population, about 30,650,000.

C. Chief Products:

a. Brazil Produces Two-Thirds of the World's Coffee and is an Important Source of Rubber: 3072, 822.

b. Other Products: Sugar, Hides and Leather, Cotton, Meat, Cocoa, Tobacco, Beans, Yerba Maté, Timber, Diamonds, Platinum, Gold, and Manganese.

D. Chief Cities: Rio de Janeiro (capital) 3020, São Paulo, Bahia, Pernambuco, Para (or Belem), Porto Alegre, and Manaos.

IV. ECUADOR: 1078.

A. Boundaries and Chief Physical Features: Ecuador is bounded on the north and northeast by Colombia, on the east and south by Peru, and on the west by the Pacific Ocean. The Andes Mountains and Highlands occupy the western half of the country, surrounding a small plain on the Gulf of Guayaquil; the eastern half is part of the Amazon Basin.

B. **Area, about 116,000 square miles (settlement of boundary disputes with Peru may increase this area); Population, about 2,000,000.**

C. **Chief Products:** Cocoa, Coffee, Rubber, Vegetable Ivory, Tobacco, Gold, and Panama Hats.

D. **Chief Cities:** Guayaquil and Quito (capital).

V. PERU: 2741.

A. **Boundaries and Chief Physical Features:** Peru is bounded on the north by Colombia and Ecuador, on the east by Brazil and Bolivia, on the west and southwest by the Pacific Ocean, and on the south by Chile. The Andes cover southern, central, and northwestern Peru, with the exception of a small coastal plain in the northwestern corner. A narrow strip of eastern Peru and a large tongue of land in the northwest belong to the Amazon Basin. This tongue of land consists chiefly of the valley of the Maranon River (105).

B. **Area, about 722,000 square miles (including some of the disputed regions); Population, about 4,500,000.**

C. **Chief Products:** Sugar, Cotton, Rice, Cocoa, Coffee, Wool, Hides, Quinine, Cocaine, Rubber, Copper, Petroleum, and Silver.

D. **Chief Cities:** Lima (capital) 2009, and Callao.

VI. BOLIVIA: 448.

A. **Boundaries and Chief Physical Features:** Bolivia is bounded on the north and east by Brazil, on the west by Peru and Chile, on the south by Argentina and Paraguay. Bolivia and Paraguay are the only South American countries which are cut off from the sea. The Andes and a high enclosed tableland occupy central and southwestern Bolivia, the remainder is divided between the Amazon Basin and the basin of the Paraguay River.

B. **Area, about 514,000 square miles; Population, about 3,000,000.**

C. **Chief Products:** Tin, Silver, Rubber, Copper, Lead, Zinc, Cocoa, and Coffee.

D. **Chief Cities:** La Paz (the actual seat of government), Cochabamba, Sucre (the nominal capital).

VII. CHILE: 735.

A. **Boundaries and Chief Physical Features:** Chile is bounded on the north by Peru, on the east by Bolivia and Argentina, and on the west by the Pacific Ocean; on the south the boundary extends at a right angle across the tip of the continent to the Atlantic, then drops southward again through Tierra del Fuego. The Andes cover all of Chile, enclosing in the north a strip of lowland called the Atacama Desert, and in the center a long strip of fertile valley land. The rugged southern coast is fringed with numerous islands.

B. **Area, about 290,000 square miles; Population, nearly 4,000,000.**

C. **Chief Products;** Nitrates, Copper, Coal, Manganese, Silver, Wheat, Grapes, Beans, Hides and Leather, Meat, and Wool.

D. **Chief Cities:** Santiago (capital) 3125, Valparaiso 3615, Concepcion, Antofagasta.

VIII. PARAGUAY: 2676.

A. **Boundaries and Chief Physical Features:** Paraguay (including disputed territory) is bounded on the north by Bolivia, on the northeast and east by Brazil, and on the west, south, and southeast by Argentina. Paraguay, like Bolivia, has no coastline. It has no mountains or important highlands, but lies entirely in the Paraguay-Parana River Basin.

B. **Area, about 195,000 square miles (including about 130,000 square miles which is in dispute with Bolivia); Population, about 1,000,000.**

C. **Chief Products:** Live Stock, Meat and Hides, Yerba Maté, Tobacco, Oranges, and Sugar.

D. **Chief Cities:** Asuncion (capital) and Villa Rica.

IX. ARGENTINA: 190.

A. **Boundaries and Chief Physical Features:** Argentina is bounded on the north by Bolivia and Paraguay, on the east by Brazil, Uruguay, and the Atlantic Ocean, and on the west and south by Chile. The western strip of Argentina is occupied by the Andes mountains and their semi-desert slopes; the middle and eastern strips consist of lowlands divided as follows: in the north, the Gran Chaco forest lands; in the center, the Pampas grasslands; and in the south, the bleak prairies of Patagonia.

B. **Area, 1,153,000 square miles; Population, about 9,000,000.**

C. **Chief Products:** Meat, Hides, Wool, Wheat, Corn, Flax, Oats, Cotton, Sugar, Grapes, Tobacco, Clothing, and Petroleum.

D. **Chief Cities:** Buenos Aires (capital) 525, Rosario, Cordoba, La Plata, Tucuman, Santa Fé, and Mendoza.

X. URUGUAY: 3607.

A. **Boundaries and Chief Physical Features:** Uruguay is bounded on the north and northeast by Brazil, on the southeast by the Atlantic Ocean, on the south by the mouth of the Plata River, and on the west by Argentina. The country consists almost entirely of a low fertile plain, watered by numerous streams.

B. **Area, about 72,200 square miles; Population, about 1,460,000.**

C. **Chief Products:** Cattle, Wool, Hides, Wheat, Flax, Oats, Grapes, Tobacco, Olives, Gold.

D. **Chief Cities:** Montevideo (capital) 2316, and Salto.

XI. GUIANA: 1546.

A. British Guiana:

a. **Boundaries and Chief Physical Features:** British Guiana is bounded on the north and northeast by the Atlantic, on the east by Dutch Guiana, on the west by Venezuela and Brazil, and on the south by Brazil. The Guiana Highlands rise on the south and west, the remainder consisting of a low coastal plain.

b. **Area, about 90,000 square miles; Population, about 310,000.**

c. **Chief Products:** Sugar, Rum, Timber, Coconuts, Rice, Diamonds, and Gold.

d. **Capital and Chief City, Georgetown.**

B. **Dutch Guiana or Surinam:**

a. **Boundaries and Chief Physical Features:** Dutch Guiana is bounded on the north by the Atlantic, on the east by French Guiana, on the west by British Guiana, and on the south by Brazil. More than half the country lies in the Guiana Highlands.

b. **Area, 46,060 square miles; Population, about 113,000.**

c. **Chief Products:** Sugar, Cocoa, Bananas, Coffee, Rice, Corn, Molasses, and Gold.

d. **Capital and Chief City, Paramaribo.**

C. **French Guiana:**

a. **Boundaries and Chief Physical Features:** French Guiana is bounded on the north and northeast by the Atlantic, on the southeast and south by Brazil, and on the west by Dutch Guiana. The country is divided about equally between the Guiana Highlands and the coastal plain.

b. **Area, about 32,000 square miles; Population, about 50,000.**

c. **Chief Products:** Gold, Silver, Iron, Phosphates, Rice, Corn, Sugar, and Tobacco.

d. **Capital and Chief City, Cayenne.**

EUROPE

JUDGED by its size alone, Europe is a minor division of the Earth's surface. Indeed, it is little more than a broken and irregular peninsula projecting westward from the vast land mass of Asia, and it is treated as a separate continent only because of its racial and historical individuality. Between Europe and Asia there is no sharp natural division as there is between Asia and Africa or North and South America. Many geographers, in fact, treat the two together under the name of Eurasia. Of the six so-called continents, Australia alone is smaller than Europe. Yet, in the history of modern civilization and in the broadest geographical sense, Europe has played by far the most important part of all the continents. It has given its "point of view" to the world. When we speak of the discovery of a country, we mean its discovery *by Europeans*. The New World was "new" only from the European standpoint, not from that of the Aztecs or Incas or Iroquois. Americans still speak of eastern Asia as the "Orient" and the "Far East," although, by the closest route from America these lands lie to the West or Occident. That is because North and South America are the heirs of Europe, in race, language, customs, and ideas. The same is true of Australia and Africa and the islands of the Pacific. Only the ancient civilizations of Asia have been able to withstand the dominating influences which spread from the shores of the Mediterranean and the eastern Atlantic. Why did Europe prevail over so much of the world in this extraordinary manner? An adequate answer to that question would involve countless subtle forces and influences which it is perhaps impossible to analyze fully, but it is certain that Geography would play an important part in the solution of the problem. In the various sections of this outline we shall review briefly some of the more important geographical factors in the supremacy of Europe.

I. POSITION AND AREA:

A. **Europe is situated in the center of the land masses of the globe, about equally distant from the midpoints of all the four larger continents. This gives Europe an enormous commercial and political advantage. This advantage of position will be made apparent by a glance at the map of the world on page 2973.**

B. **The area of Europe (about 3,900,000 square miles) is about half that of South America; about two-fifths of North America; about one-third of Africa; and slightly more than one-fifth of Asia. The overcrowding of this comparatively small area forced Europe to seek food supplies in other lands, and an outlet for its surplus population.**

II. PHYSIOGRAPHY:

A. **Geologic Influences:**

a. **The Glaciers of the Ice Age Covered Most of Northern Europe: 1720, 1466.**

b. **The Sinking of the Land:** The exceedingly irregular outline of Europe, with its countless peninsulas and bays, its land-locked seas, and its numerous islands, indicates that the continent, after emerging from the oceans in remote geologic ages, has sunk back again to a certain extent, allowing the water to invade its lowest areas (1187).

1. Great Britain was once part of mainland: 1191.
2. North Sea was once dry land: 2528.
3. Fiords of Norway created by sinking of seacoast: 2529–30, 2788, 2789 (picture).
4. Italy and Spain were once connected by land with Africa: 3230, 3299.
5. See map of Heights and Depths opposite page 1190; the white areas indicate waters less than 500 feet deep, where the land probably projected at comparatively recent geologic periods.

B. **Mountains and Highlands: 1190.** The mountains of Europe are, as a whole, comparatively low and scattered, and nowhere do they cut off large interior areas from the moist sea winds, as do the mountains of other continents. The result is that Europe has well-distributed rainfall and is the only continent which has no desert regions. In general the mountains of the south are young in the geographic sense, while those of the north are old and worn-down ranges.

a. **Central and Southern Mountain Groups.** The following mountains are all more or less linked together by intervening highlands: **Alps 101; Apennines 154; Dinaric Alps 1190; Transylvanian Alps 3081; Carpathian Mountains 646; Balkan Mountains and Pindus Mountains 307.**

b. **Central Highlands: 1192.** In this group are included the following: **French Highlands 1345; Jura Mountains 1903; Vosges Mountains 3662; Black Forest 433; Bavarian Highlands 346; Thuringian Hills and Harz Mountains 1439-40, 1595;** and **Bohemian Mountains 447.**

c. **Southwestern Mountains and Highlands: Pyrenees 2940; Sierra Nevada** and other ranges and plateaus forming part of the Iberian or Spanish Peninsula **3299** (table), **3300** (map).

d. **Northwest Highlands:** These are the remains of an ancient mountain chain which once stretched in a great unbroken curve from the western tip of France, through the British Isles, across what is now the North Sea, and up into the Scandinavian Peninsula. They include the following: **Brittany Highlands 514, 1345; Highlands of England and Wales, Ireland and Scotland 1150, 3664, 1807, 3146; Kiolen Mountains of Scandinavia 2529, 3402; Manselka Mountains of Finland 1248.**

e. **Mountains of the Extreme East and Southeast: Ural Mountains 3606; Caucasus Mountains 663.**

C. Lowlands: Europe has a greater proportion of fertile lowland plains than any other continent.

a. **Great Central Lowland: 1190-1.** In western Europe the lowland plains are hemmed in between the Central Highlands and the Northwestern Highlands, and are cut up by the arms of the sea; but in eastern Europe, the plains broaden out, covering virtually all of European Russia. The regions included are as follows: **English Plain 1150; Paris Basin 1345; Lowlands of Belgium and Holland 372, 2438; North German Plain 1439; Plains of Denmark and Southern Sweden 994, 3402;** and **Great Plains of Russia 3085.**

b. **Smaller European Lowlands: Hungarian Plain 1702; Lombardy Plain or Basin of the Po River 2848, 2047; Garonne Basin 1345.**

D. Coastline: **1188.** The broken coastline of Europe, with countless arms of the sea, large and small, reaching into the interior, not only provides numerous natural harbors, which have encouraged seafaring and commerce since the dawn of history, but allows the influence of these many bodies of water to temper the climate of the continent. For the names of the principal bays and gulfs, see the map next to page 1196.

a. **Effect of Natural Harbors on Civilization: 1578.**

b. **Europe's Coastline Compared with Africa's: 33.**

E. Seas and Chief Rivers Flowing into Them:

a. **Mediterranean: 2193.** Because the southern mountain ranges crowd so close to its shores, there are comparatively few important rivers flowing into the Mediterranean: **Rhone River 3012.**

—Chief Divisions of the Mediterranean: **Adriatic Sea 26,** into which empties the **Po River 2848;** and **Aegean Sea 27.**

b. **Atlantic Ocean: 254.**

1. Rivers of the Iberian Peninsula: **Guadalquivir, Guadiana, Tagus, and Douro 3299** (table).
2. French Rivers: **Garonne 1345; Loire 2047.**

c. **North Sea and English Channel: 2528.**

—**Seine River 3173; Thames 3482; Meuse 2207; Rhine 3005; Elbe 1107.**

d. **Baltic Sea: 321.**

—**Oder River 1439; Vistula 3651.**

e. **White Sea,** with the **Dvina River;** and **Arctic Ocean,** with the **Pechora River: 1188, 3085.**

f. **Black Sea: 434.**

—**Danube River 961; Dnieper, Don, Dniester 1188.**

g. **Caspian Sea: 653.**

—**Volga River 3660.**

F. Chief Islands Belonging to Europe: **Iceland 1722; Great Britain 1509; Ireland 1807; Danish Islands 994; Balearic Isles 307; Corsica 894; Sardinia 3126; Sicily 3229; Crete 918.**

III. CLIMATE: 1188, 1194.

A. Climate of Europe is Chiefly of the Oceanic Type: **794-5.**

a. **Russia has Continental Climate Similar to North American Plains: 3086.**

b. **Gulf Stream Warms Western Europe: 1549.**

c. **Scandinavia and Southern Italy Present Two Extremes: 2530, 1835.**

d. **Effect of Warm West Winds: 1188.**

B. Rainfall: see map opposite page **1190,** and map on page **2973.**

There are no high mountain ranges in the west to prevent moist Atlantic winds from penetrating the heart of Europe. The even distribution of rain enables the fertile soil of the extensive lowlands to produce maximum crops with great regularity.

IV. PEOPLES OF EUROPE:

A. Prehistoric Races: **2133, 666.**

B. Primitive Stock of Present Races: **2956.**

C. Racial Groups of Historic Times: **3866-7.**

D. Diversity of Types, Customs, and Language: **1192-3.** The fact that Europe is cut up into many separate little regions by short mountain chains and by arms of the sea has tended to produce a tremendously varied and versatile group of independent types, each contributing in a different way toward a single great continental civilization.

Great Britain and Ireland

CUT off by water from the rest of Europe, Great Britain has been compelled to develop its commerce by sea. As the population of these small islands increased, the products of the home farms no longer sufficed to feed the inhabitants, and Great Britain was compelled to buy foreign food. To pay for this food, manufacturing industries had to be developed. The presence of coal and minerals on the islands favored this development. To maintain the manufacturing industries, raw materials had to be imported. To establish sure sources of raw materials and to control markets for manufactured products, Great Britain struggled for and obtained colonies in all quarters of the globe. To protect this colonial empire, Great Britain built a powerful navy. These are the chief factors in the evolution of these small islands into a world power controlling one-fourth of the inhabitable lands of the earth.

I. PHYSIOGRAPHY:
- A. **Islands with Irregular Coastline Produced by Sinking of Land: 2528, 3146.**
- B. General Characteristics:
  - a. **Description of English Country: 1150, 1157–8.**
  - b. **Wales, a Country of Hills and Low Mountains: 3664.**
  - c. **Scotland and Its Highlands: 3146.**
  - d. **Ireland, an Inland Plain Surrounded by Low Mountains: 1807.**
- C. **Soil: Fertile in England 1150; Poor in Scotland 3146; Thin in Ireland 1807.**
- D. **Lesser Islands:** Hebrides 1625; Shetland Islands 3206; Isle of Man 2134; Orkney Islands 2601; Channel Islands 687.

II. CLIMATE AND NATURAL RESOURCES:
- A. **Climate Tempered by Gulf Stream; Has No Great Extremes of Temperature: 1150, 1549.**
- B. **Heavy Rainfall in Most Parts of the British Isles: 1158, 3147, 1807.**
- C. Natural Resources:
  - a **Irregular Coastline Provides Many Good Harbors: 1150.**
  - b. **Coal, Iron, Tin, Copper, Zinc, and Lead: 1150, 1158, 3664, 3504.**
  - c. **Rich Fishing Ground in the North Sea: 2528.**

III. CHIEF INDUSTRIES:
- A. **Manufacturing:** Cotton Goods 1158; Woolens 1160; Linen 1807–8, 1291 (picture); Silk 3235; Porcelain and Pottery 2883, 2906; Iron and Steel Products 1826; Shipbuilding 3146.
- B. **Mining:** See references to minerals under Natural Resources.
- C. **Fisheries: 1286, 3147.**
- D. **Agriculture: 3146, 1807–8.**
- E. **Stock Raising and Dairying: 1807.**

IV. COMMERCE AND TRANSPORTATION:
- A. **History of English Trade: 1154–5.**
- B. **Importance of Trade with Colonies: 265, 269, 2499.**
- C. Transportation:
  - a. **British Shipping; Importance of Sea Power: 1154–5, 3219, 2424.**
  - b. **Rivers and Canals: 1985, 2134, 1150, 625–6, 3482.**

V. CHIEF CITIES:
- A. **In England: London 2048; Birmingham 427; Liverpool 2031; Manchester 2134; Sheffield 3200; Leeds 1985; Bristol 510; Newcastle-upon-Tyne 2449; Portsmouth 2887; Plymouth 2841; Southampton 3290; Dover 1027.**
- B. **In Scotland: Glasgow 1470; Edinburgh 1080; Aberdeen 2.**
- C. **In Ireland: Dublin 1043; Belfast 371; Cork 888; Queenstown 2950.**

Note: These cities are all seaports, or closely connected with the sea by great systems of canals.

BRITISH POSSESSIONS

I. **SELF-GOVERNING DOMINIONS: Australia 261; Canada 601; Ireland 1807; New Zealand 2499; Union of South Africa 3279.**

II. **INDIAN EMPIRE AND ASSOCIATED STATES: 1743.**

III. COLONIES, PROTECTORATES, AND DEPENDENCIES:
- A. **In Europe: Gibraltar 1458; Malta 2131.**
- B. In Africa:
  - a. **Egypt and the Anglo-Egyptian Sudan: 1092.** In March 1922 Egypt was declared independent, Great Britain retaining control of foreign relations and defense.
  - b. **British Somaliland: see map next to page 41.**
  - c. **British East Africa: 1068.** This includes **Kenya Colony** and **Protectorate** (former East Africa Protectorate), **Uganda Protectorate, Tanganyika Territory** (former German East Africa) **3432, Zanzibar Protectorate** and **Pemba 3838.**
  - d. **Nyasaland Protectorate: see map next to page 41.**
  - e. **South Africa: 3279.** This comprises those British possessions which are not part of the Union of South Africa, as follows: **Rhodesia, Bechuanaland, Swaziland,** and **Basutoland.**

  f. **Southwest Africa Protectorate** (former German colony now administered by Union of South Africa): **3283.**
  g. **West Africa Colonies: 40–1.** These include **Nigeria, Gold Coast, Sierra Leone, Gambia,** and portions of the former German colonies of **Cameroon** and **Togoland.**
  h. **Islands: Mauritius 2174; St. Helena and Ascension Island (map opposite page 41).**
C. In Asia: Cyprus 947; Aden 24; Bahrein Islands 2738; Ceylon 684; Laccadive Islands 1763; Andaman and Nicobar Islands 1756; Straits Settlements 2130; Malay States 2130; Hongkong 1678; Weihaiwei 3195.
Note: Great Britain holds a mandate over **Palestine** (2643) and a protectorate over the Arab kingdom of **Irak** which comprises **Mesopotamia** (2200).
D. In North and South America: Bermudas 386; Bahamas 305; Barbados 329; British Honduras 1676; Jamaica 1859; British Leeward Islands and British Windward Islands 3895; Trinidad and Tobago 3541; British Guiana 1547; Falkland Islands 1223.
E. Islands of the Pacific: British Borneo 468; British New Guinea (including Papua and the former German section of the island) **2451; New Britain Islands** (formerly the Bismarck Archipelago) and **Solomon Islands 2620; New Hebrides** (ruled jointly with France) **2620; Fiji Islands 1239; British Samoa 3120; Santa Cruz Islands, Gilbert and Ellice Islands, Tokelau Islands, Tonga Islands, Cook Islands 2620–1, 2624.**
Note: The former German section of New Guinea, the New Britain Islands, and the former German islands of the Solomon group are now under the Australian Commonwealth; former German Samoa and the Cook Islands are under the New Zealand Commonwealth.

France

FRANCE is the most favorably situated of all the countries of Europe. Stretching from the North Sea to the Mediterranean, and facing the Atlantic Ocean on the west, France has broad open gateways to all avenues of world commerce. Having many neighbors to trade with—England, Belgium, Germany, Switzerland, Italy, Spain, and others only a little farther away—France is yet protected by mountains and water on all sides, except along the Belgian boundary. France's position gives her a variety of climate, ranging from the semitropical on the Mediterranean to the invigorating climate of Normandy, so that the soil will produce, with the aid of the abundant rains, almost any kind of crop. Yet these very advantages have in a measure held France back in the rivalry for world trade. Able to satisfy with home products virtually all their frugal requirements, the French have had in the past little incentive to strive for foreign commerce; nor has France been so overcrowded that the people have been compelled to emigrate and establish French trade in foreign lands. France's position as a world power, therefore, is not based on commercial success, as is Great Britain's, but rather upon the close bonds which hold the French people united in a spirit of strong nationalism, as well as upon the traditions of culture and intellectual leadership which prevail in the land.

I. PHYSIOGRAPHY:
  A. Mountains and Highlands:
    a. Chief Ranges: Alps 101; Pyrenees 2940; Jura Mountains 1903; Vosges Mountains 3662.
    b. Lesser Ranges and Highlands: Ardennes Hills 1344; Auvergne Mountains and Cévennes Chain 1345; Highlands of Brittany and Normandy 1345, 514.
  B. Plains: 1192, 1344; Paris Basin 1345; "Land of River Valleys" 1193.
  C. Chief Rivers: 1345.
    —Seine 3173; Loire 2047; Gironde and Garonne 1345; Rhône 3012.
  D. Coastline:
    a. Why France Has Few Natural Harbors: 1344.
    b. Peninsulas and Bays: Peninsula of Brittany 514, 1344; Norman Peninsula 2513, 1344; Bay of Biscay and Gulf of the Lion 1344.
  E. Island of Corsica: 894.
II. CLIMATE: The winds from the Atlantic bring abundant moisture and keep the temperature mild 1346.
III. NATURAL RESOURCES:
  A. Fertile Soil: 1346.
  B. Minerals: Coal, Iron, and Building Stone 1347–8.
  C. Rivers Form Network of Valuable Waterways: 1346.
  D. Forest Lands 1347.
IV. CHIEF INDUSTRIES AND PRODUCTS:
  A. Agriculture is the Most Important Industry: 1346.
    a. Principal Crops: Wheat, Oats, Rye, Barley, Potatoes, and Sugar Beets.
    b. France Leads in Grape Growing: 1501, 1346.
    c. Live Stock: Cattle, Horses, Sheep, Goats, Hogs, and Poultry 1346.
    d. Small Farms and Peasant Ownership: 1347.
  B. Fisheries: 1347, 1282. The principal products of the fisheries are Cod 1283; Oysters 2615, 2614 (picture); Sardines 3126.
  C. Mining and Quarrying: 1347–8.
  D. Manufacturing: Textiles and Leather 1348; Wine 1346; Gloves 1475; Perfumes 2728; Soap 3263; Porcelains 2883; Iron and Steel Products 1348; Sugar 3385.

- **E. Transportation:**
  - **a. Rivers and Canals: 1193, 1346, 625, 3012, 3173, 2047, 2207.**
  - **b. Wonderful System of Roads: 1348.**
  - **c. Railways Owned in Part by Government: 1348.**
- **V. CHIEF CITIES: Paris** (capital) **2681, 1348; Marseilles 2154; Lyons 2092; Bordeaux 466; Lille 2008; Strasbourg 103; Nantes 2389; Toulouse 1351** (map); **St. Etienne 1348; Nice 2505; Hâvre 1601; Rouen 2513; Roubaix 1348; Nancy 1348; Reims 2992; Amiens 117; Brest 502; Calais 570; Orléans 2601; Metz 2206; Versailles 3633; Dunkirk 1048.**

FRENCH POSSESSIONS

- **I. IN AFRICA:**
  - **A. On the Mediterranean: Algeria** (including part of the northern Sahara) **96; Tunis 3549; Morocco 2327.**
  - **B. French West Africa: 40.** This includes the following colonies: **Sénégal, French Guinea, Dahomey, French Sudan, Upper Volta, Mauritania, Togo** (part of the former German Togoland), and most of the **Sahara** Desert (3105).
  - **C. French Equatorial Africa or French Congo** (including a part of the former German Cameroon): **40, 859.**
  - **D. Other Colonies: Madagascar 2105; French Somaliland** (map next to page 41); **Reunion Island** (see Fact-Index).
- **II. IN ASIA: French India 1756; French Indo-China 1777; Kwangchow 740** (map).
- **III. IN AMERICA: St. Pierre and Miquelon** (see Fact-Index); **Guadeloupe and Dependencies 1545; Martinique 2156; French Guiana 1547.**
- **IV. IN PACIFIC OCEAN: 2620, 2624.** These possessions include **New Hebrides** (owned jointly with Great Britain), **Loyalty Islands, New Caledonia, Marquesas Islands, Tuamotu Group, Society Islands** (including **Tahiti**), **Tubuai Islands,** and **Wallis Islands.**

Belgium

BELGIUM is primarily a manufacturing nation. Most of the population is crowded into industrial centers, while the countryside is covered with small farms which are made to yield enormous crops by intensive cultivation along scientific lines. The portions of the Ardennes Highlands in the south which are not suitable for agriculture are devoted to live stock, principally sheep. Only along the sandy seacoast is there any considerable area of waste land. This thrifty use of every resource enables Belgium to support a greater number of people to the square mile than any other country in Europe. It is bounded on the north by the North Sea and the Netherlands, on the east by Germany and Luxemburg, and on the west and south by France.

- **I. PHYSIOGRAPHY:**
  - **A. General Character of the Country: Sand Dunes along the Sea, Hills in the South, Fertile Plains in Between 372, 376.**
  - **B. Chief Rivers: Scheldt 3136; Meuse 2207.**
- **II. CLIMATE:** The climate of Belgium is like that of northern France and southern England, with mild winters, cool summers, and an abundance of rain.
- **III. NATURAL RESOURCES:**
  - **A. Chief Minerals: Coal, Iron, Tin, Sand for Making Glass 374, 376.**
  - **B. Good Farm Land: 372.**
- **IV. CHIEF INDUSTRIES:**
  - **A. Agriculture: 372. Principal Crops are Wheat, Rye, Flax, and Sugar Beets.**
  - **B. Mining and Fisheries: 374.**
  - **C. Manufacturing is the Leading Industry: 374, 376. Chief Products are Iron and Steel, Artificial Silk, Automobiles, Glass, Lace, Linen, Wool, Gloves, and Sugar.**
  - **D. River and Canal Navigation: 2207, 3136, 625, 374** (picture).
- **V. CHIEF CITIES: Brussels** (capital) **520; Antwerp 152; Liége 1995; Ghent 1456; Bruges 518; Ostend 374; Louvain 2073.**
- **VI. BELGIAN COLONIAL TERRITORY: Congo State 859.**

LUXEMBURG

GRAND DUCHY OF LUXEMBURG: 2085. This is a small neutral territory lying between France, Belgium, and Germany. **Its industries and other characteristics are similar to those of Belgium.**

Switzerland

THIS small nation came into existence more than 500 years ago, the first of the countries of Europe to achieve popular liberty and a democratic form of government. Its power and wealth in those days was due to the fact that it was situated along the highways of commerce between Italy, Germany, and France. Switzerland has been able to maintain its independence throughout all the struggles that have swept Europe in the last five centuries for three chief reasons: (1) the bold liberty-loving character and military skill of its people, (2) the protection afforded by the strong rivalry between neighboring states, none of which was willing to permit the other to occupy this strategic position in the Alps, and (3) the lack of great natural resources to tempt the more powerful nations to such determined efforts as would be necessary to seize and hold this vast natural fortress. Switzerland today is a land devoted to agriculture, manufacturing, and commerce—all on a small scale. Among the principal sources of prosperity are the scenery and climate which annually attract thousands of tourists who leave behind them great sums of money.

I. PHYSIOGRAPHY:
   A. **Mountains: Alps 101; Jura Mountains 1903.**
   B. **Narrow Plateau between the Two Ranges: 3412.**
   C. **Rivers Rising in Switzerland: Rhine 3005; Rhone 3012; Aar 3412, 3414; Ticino 3414; Inn 3414.**
   D. **Other Physical Features: Many Lakes 3414; Majestic Glaciers 3417.**
II. CLIMATE: **101. The general altitude of Switzerland produces a climate much cooler than that of the surrounding lowlands.**
   There are heavy rains in summer and great snowfalls in winter.
III. NATURAL RESOURCES: The chief resources are the scenery (3413, 3417), the pasture land (3415), and the plentiful supply of water-power (3416).
IV. CHIEF INDUSTRIES:
   A. **Tourist Business: 3416.**
   B. **Dairying and Agriculture: 3415. Chief Crops are Wheat, Rye, Oats, and Potatoes.**
   C. **Manufacturing: 3415. Chief Products are Watches and Clocks, Silk and Cotton Goods, Cheese and Condensed Milk, Chocolate, Machinery, Clothing, and Salt.**
V. CHIEF CITIES: **Bern (capital) 386; Zurich 3842; Geneva 1411; Basel (see Fact-Index).**

The Netherlands

NO nation in the world can boast of a more orderly civilization than that of the Netherlands, or Holland as it is more commonly called. With quiet determination and infinite patience, the Hollanders or Dutch have turned their small corner of land into a model country, overcoming vast natural obstacles, driving back the sea with dikes to make room for their carefully tended fields and dairy farms, and founding thriving factories despite the lack of coal and iron. Holland is primarily a commercial nation, whose prosperity rests upon thrift and the Dutch merchant's world-wide reputation for rigid honesty. The efficiency of the government is founded on the sound education of the people. Holland's important colonial empire is a reminder of the days when Dutch explorers and Dutch merchants boldly sailed into unknown seas in search of new lands and new markets.

I. PHYSIOGRAPHY:
   A. **Alluvial Soil Brought by Three Rivers: 2438.**
   B. **Nearly Half the Land is Below Sea Level: 2438.**
      a. **How the Sea is Kept Out: 1191 (picture).**
      b. **How the Marshes are Reclaimed: 1827.**
   C. **Land is Not Naturally Fertile: 1193.**
   D. **Rivers: Rhine 3005; Meuse or Maas River 2207; Scheldt 3136.**
II. CLIMATE: Holland has the typically mild European climate 1188.
III. NATURAL RESOURCES: With the exception of a favorable situation for ocean commerce, a considerable area of pasture land, and some deposits of pottery clay, Holland has virtually no important natural resources.
IV. CHIEF INDUSTRIES:
   A. **Dairying and Dairy Products: 2438–40.**
   B. **Agriculture: Chief Crops are Rye, Oats, Potatoes, Sugar Beets, and Wheat.**
      —Tulip Raising an Important Industry: 3547, 2440.
   C. **Manufacturing: Textiles, Ropes, Dyes, Chemicals, etc.: 119, 3612, 3068.**
      —Holland is Famous for Diamond-Cutting (119) and Pottery (2906).
   D. **Shipbuilding: 3068.**
V. COMMERCE AND TRANSPORTATION:
   A. **Amount of Shipping: 3219.**
   B. **Canals, Rivers, Railroads: 2438, 626.**
   C. **Colonial Trade: 2438, 1879.**
VI. CHIEF CITIES: 2440–1. **Amsterdam 119; Rotterdam 3068; The Hague** (capital) **1558; Utrecht 3612.**

POSSESSIONS OF THE NETHERLANDS

I. DUTCH EAST INDIES: **1070.**
   —Principal Islands: **Java 1877; Sumatra 3391; Borneo** (northern part belongs to Great Britain) **467; Celebes 671; Molucca Islands 1070; New Guinea** (eastern half belongs to Great Britain) **2451; Timor 1073 map** (eastern half belongs to Portugal).
II. DUTCH WEST INDIES:
   —**Dutch Guiana or Surinam 1546, 3899; Curaçao Island Group 3895.**

For additional information on topics mentioned in these Outlines

Germany

DURING the period when other nations of Europe were establishing colonies and laying the first foundations of their modern commercial prosperity, Germany remained a loose federation of states whose minor rivalries prevented any concerted national enterprise. When, under the leadership of Prussia, these states finally united to form the German Empire, most of the territory available for colonial expansion was already occupied. Neither the character of soil and climate nor the temper of the people inclined Germany to remain an agricultural nation like France. Already the products of the farms were insufficient for the expanding population. Germany's only opportunity lay in manufacturing and commerce. To sell the products of its factories, Germany was forced to compete for trade in lands over which it had no political control. The German merchants met the problem by such efficient organization that they were able to turn out goods of standard quality at a low price. The government aided them with subsidies when necessary, and soon Germany was the leading rival of Great Britain for the control of the world's commerce. Had the race for supremacy remained a peaceful one, Germany's prosperity would undoubtedly have continued to grow. But the military class which controlled the government believed it saw a short-cut to world dominion. Germany chose to draw the sword, and the great structure erected by years of careful industry collapsed in ruins.

I. PHYSIOGRAPHY:
A. Highlands in the South: 1439, 1441.
a. Bavarian Highlands: 346, 1441-2; Black Forest: 433.
b. Thuringian Hills and Harz Mountains: 1439–49, 1595.
c. Erzgebirge or "Ore Mountains" of Saxony: 3131.
B. Northern Germany is Part of Great European Plain: 1439, 1440, 1190–1.
C. Chief Rivers: Rhine 3005; Ems 1439; Weser 1439, 502; Elbe 1107; Oder 1439; Vistula 3651; Headwaters of Danube 961.
D. Coastline: On the North Sea 2528; on the Baltic Sea 321.

II. CLIMATE: The climate of Germany is on the whole drier and marked by greater extremes of temperature than in the lands to the west. The winds from the Atlantic have lost much of their moisture and equable temperature by the time they reach central Germany.

III. NATURAL RESOURCES:
A. Coal, Iron, Zinc, Copper, Tin, Nickel, Lead, Potash, Sulphur, Silver, Gold, and Building Stone: 1443, 3132, 1595, 2898.
B. Forests: 1441–2, 433, 1327, 1328.
C. Water-Power in Saxony: 3132.
D. Soil of North German Plain Unfavorable to Agriculture: 1440.

IV. INDUSTRIES:
A. Manufacturing: Iron and Steel Products 1443, 1444 (picture); Textiles 1444, 3132, 303; Chemicals and Dyes 1444, 303, 1049; Pottery (Porcelain and China) 1444, 3132; Beer 347; Wine, Jewelry, and Toys 303; Wood Products 1442.
B. Agriculture: Crops are raised in the unfavorable soil of the North German Plain by scientific farming. —Principal Crops: Wheat, Rye, Barley, Oats, Sugar Beets, Hops, Potatoes, Flax, Tobacco, and Grapes 1440, 1441, 303, 347, 3385, 1680.
C. Live Stock: 1440, 347, 3132, 1595.
D. Shipbuilding and Fisheries: 1440.

V. TRANSPORTATION:
A. Railways, Rivers, and Canals: 1439, 1444, 1107, 961, 3005, 626, 1568.
B. Effect of the World War on German Harbors and Shipping: 1440, 3811.

VI. PRINCIPAL DIVISIONS OF GERMANY: Prussia 2928; Bavaria 346; Württemberg 1441; Baden 303; Saxony 3131; Mecklenburg-Schwerin (see Fact-Index); Thuringia 3715; Hesse 1441; Oldenburg, Brunswick, Mecklenburg-Strelitz, Anhalt, Lippe, Waldeck, and Schaumburg-Lippe (see Fact-Index); Hamburg 1567; Lübeck 1576; Bremen 502.

VII. CHIEF CITIES: Berlin (capital) 385; Hamburg 1567; Münich 2369; Leipzig 1985; Dresden 1041; Cologne 833; Breslau (see Fact-Index); Frankfort-on-the-Main 1356; Düsseldorf 1443; Nüremberg 2543; Hanover 1576; Essen 1178; Chemnitz 3132; Stuttgart 1441; Magdeburg 1107; Bremen 502; Königsberg 1440; Stettin 1440; Aachen 1.

TERRITORY LOST THROUGH WORLD WAR

I. HOMELAND TERRITORY: Alsace-Lorraine to France; Saar Basin Coal Mines to France; Moresnet, Eupen, and Malmédy to Belgium; part of Schleswig to Denmark; 22,500 square miles of eastern Germany to Poland, including a strip of Prussia giving Poland access to the Baltic Sea; part of Upper Silesia to Poland; the ports of Danzig and Memel to the League of Nations.

II. COLONIAL TERRITORY: Most of German East Africa, all of German Southwest Africa, part of Togoland, and part of Cameroon to Great Britain; remainder of Togoland and Cameroon to France; part of German East Africa to Belgium and part to Portugal; German New Guinea, Bismarck Archipelago, Solomon Islands, German Samoa, and Nauru Island to Great Britain; Kiaochow, Caroline Islands, Marshall Islands, Mariana Islands or Ladrones, and Pelew Islands to Japan.

Denmark

DENMARK consists of the peninsula of Jutland and several islands lying at the entrance of the Baltic Sea. Although their land borders on Germany, the Danes are more closely connected by race, customs, and traditions to Sweden and Norway (3134). Denmark has few important natural resources. Coal and iron are lacking, and, despite the favorable situation, foreign commerce is difficult because the low sandy shores have few harbors that will accommodate large ships. Denmark's prosperity, therefore, is the outgrowth of the thrift and enterprise of the people, their marvelous coöperative industries, and the high degree of public education.

I. PHYSIOGRAPHY:
- **A. Peninsula of Jutland: Stormy Barren West Coast and Protected Smiling East Coast 994–6.**
- **B. Islands More Important than Peninsula: Fünen, Zealand, Laaland, Falster, Möen, and Bornholm 996.**
- **C. Character of the Surface: Low Plains, Woodlands, and Swamps: 994–6.**
- **D. Coastline Faces North Sea and Baltic: 2528, 321.**

II. CLIMATE: Denmark is exposed to cold and damp winds, which bring an abundance of moisture.

III. NATURAL RESOURCES: Farmland, pasture land, pottery clay, and fishing waters are the only natural sources of wealth 994, 996.

IV. INDUSTRIES:
- **A. Agriculture is the Chief Industry: 994.**
  - **a. Chief Crops: Oats, Rye, Barley, Potatoes, Sugar Beets, Hay.**
  - **b. Importance of Dairying: 996, 953.**
  - **c. Effective Work of Coöperative Societies: 879, 996.**
- **B. Fisheries: Cod, Salmon, Shrimp, Lobster, Haddock, Herring, and Flounder 994.**
- **C. Manufacture of Porcelain: 996.**

V. CHIEF CITIES: Copenhagen (capital) 880, Aarhus, Aalborg, and Odense 996.

POSSESSIONS OF DENMARK

I. FAROE ISLANDS: 997. These islands, lying about midway between Scotland and Iceland, are considered part of Denmark, having representatives in the Danish Legislature. Area, 540 square miles; population, about 20,000. Chief industries, fishing and sheep raising.

II. GREENLAND: 1539. This, the largest island in the world, is the only true colony of Denmark. Area is estimated at about 800,000 square miles, of which only 46,740 square miles are under settled government. Population (mostly Eskimos), about 14,000. Chief industries, fishing, seal hunting, trapping, and cryolite mining.

ICELAND

ICELAND: 1722. This island, formerly a Danish colony, has had an independent sovereign government since 1918. It forms, however, a loose union with Denmark, the Danish king being also king of Iceland. Area, 39,709 square miles; population, about 92,000. Chief industries, fishing, stock raising, and agriculture on a small scale.

Sweden and Norway

THE Scandinavian Peninsula, occupied by Sweden and Norway, is virtually an island in the commercial and economic sense. The neck of land which connects the peninsula to the European mainland is so remote in its arctic isolation that it has little practical value as a link with the rest of the world. It is, in fact, an almost unused back door. The front door of Sweden and Norway is the sea. By keeping this in mind, it will be easier to understand the characteristics of these two countries. Furthermore, the features which distinguish Sweden and Norway from each other can be largely traced to differences between the seas which they face. Norway, exposed to the tempering winds from the North Sea, has on the whole a warmer moister climate than Sweden, despite the fact that Sweden is farther to the south. The Baltic Sea harbors of Sweden are usually ice-locked throughout the winter, while most of the Norwegian seaports, snuggled in the deep fiords, are free the year around. While this makes Norway a more important sea-faring nation than Sweden, the excessive rains combined with the poor soil keep its agricultural development far behind that of Sweden. The two countries, however, are closely related by race and tradition. The people of the Scandinavian peninsula are vigorous and thrifty, and make excellent use of their broad political freedom. In the countries to which they emigrate they become as a rule valuable and prosperous citizens.

SWEDEN

I. PHYSIOGRAPHY: See map on page 2531.
- **A. Separated from Norway by Kiolen Mountains: 3402.**
- **B. Divided into Three Natural Regions:**
  - **a. Götaland, a Fertile Region in the Extreme South: 3402–3.**
  - **b. Svealand, a Middle Region of Lakes and Hills: 3402.**
  - **c. Norrland, a Northern Region of Vast Forest-Covered Mountains: 3403.**
    —Includes part of Lapland: 1962.

- C. **Coastline is Irregular, Rocky in Places, Sandy in Others: 3402, 321.**
  - —Part of southern coast faces the Kattegat branch of the North Sea: 2528.

II. **CLIMATE: 3401.** Summers in Sweden are short, winters are long. The extremes of temperature are greater than in Norway. The mountains also cut off much of the moisture carried on the winds from the North Sea.

III. **NATURAL RESOURCES:**
- A. **Fertile Soil in the South: 3402–3.**
- B. **Fish Plentiful in Baltic and Inland Waters: 3402, 3404.**
- C. **Forests and Mineral Deposits: 3404.**
- D. **Navigable Rivers and Water Power: 3404.**

IV. **INDUSTRIES:**
- A. **Agriculture is the Most Important Industry: 3404. Chief Crops are Oats, Rye, Barley, Potatoes, and Sugar Beets.**
- B. **Lumbering and Mining (Iron, Copper, Silver, and Zinc): 3404.**
- C. **Fisheries: 1285, 3402.**
- D. **Manufacturing: 3404. Chief Products are Matches, Furniture, Wood Pulp, Paper, Porcelain, Glass, Textiles, Iron and Steel Products, and Sugar.**
- E. **Transportation—Railroads, Rivers, Canals, and Shipping: 3403–4, 3219.**

V. **CHIEF CITIES:** Stockholm (capital) **3357:** Göteborg, Malmö, Norrköping, and Helsingborg **3403.**

NORWAY

I. PHYSIOGRAPHY:
- A. **Separated from Sweden by the Kiolen Mountains: 2529, 2532.**
- B. **Nearly All Norway Covered with Rugged Mountains and Plateaus: 2529, 2532.**
  - a. **Effect of Ancient Glaciers on the Surface: 2788, 2529.**
  - b. **Vast Size of Modern Glaciers: 2532.**
- C. **Coastline Broken by Countless Fiords and Bordered with Small Islands: 2529–30, 2532, 2534 and 2789** (pictures).
- D. **The North Sea and the Skagerrack: 2528.**
- E. **Spitzbergen Islands: 2534, 189** (map).

II. **CLIMATE: 2530.** The temperate ocean winds and the effect of the Gulf Stream (1549) help to make the climate of Norway milder than that of Sweden and the lands farther east. The winters, however, are long and the summers short. The northern third of Norway lies inside the Arctic circle.

III. NATURAL RESOURCES:
- A. **Great Forests of Pine and Fir: 2532, 2536.**
- B. **Inexhaustible Supply of Fish in Coastal Waters: 2536.**
- C. **Some Mineral Deposits (Iron, Copper, Nickel, and Silver): 2536.**
  - —Immense Coal Deposits on Spitzbergen Islands: 2534.
- D. **Agricultural Land Confined to Small Valleys: 2530.**
- E. **Water-Power: 2536; Countless Natural Harbors: 2532.**

IV. INDUSTRIES:
- A. **Fisheries—Cod, Herring, Mackerel, Salmon, Whale: 2536, 2532–4.**
- B. **Lumbering and Lumber Products: 2532, 2536.**
- C. **Agriculture on a Small Scale—Oats, Rye, Barley, Potatoes: 2534.**
- D. **Stock Raising and Dairying: 2534.**
  - —Reindeer are raised in the extreme north: 2993, 1962, 2534.
- E. **Manufacturing—Chemicals, Machinery, and Woodenware: 2536.**
- F. **Transportation: 2536.** Norway is one of the important shipping countries of the world (3219).

V. **CHIEF CITIES:** Oslo (capital) **2602, 2530; Bergen, Trondhjem, and Stavanger 2532; Narvik 2534; Hammerfest 2534, 2536** (picture).

Finland, Esthonia, Latvia, and Lithuania

THESE four states, bordering upon the Baltic, were before the World War parts of Russia. Each declared its independence during the disorders which followed the Russian Revolution and the separate peace treaty with Germany. Since that time, these states have been supported in their independence by the western powers. The Letts of Latvia and the Lithuanians belong to an ancient Baltic race more nearly related to the old Prussians than to the Russian Slavs. The Esths of Esthonia and the Finns are descended from a western branch of the Mongolian or yellow race (3867–8). In many respects the peoples of these small countries have retained racial characteristics and traditions which set each of them apart from its neighbors.

I. **FINLAND: 1248.**
- A. **Physiography:** A country of low hills and countless lakes in the south and center, with the Manselka Mountains rising in the extreme north.
- B. **Climate:** Long cold winters and short hot summers prevail, the climate on the whole resembling that of Sweden.

C. **Resources and Products:** Valuable timber and timber products; grazing land and dairy products; mining and quarrying (copper, iron, and granite); water-power.
D. **Area, about 132,642 square miles; Population, about 3,500,000.**
E. **Capital and Chief City: Helsingfors 1248.**
Note: The Aland Islands (1248) at the mouth of the Gulf of Bothnia were assigned to Finland by the League of Nations, after the conflicting claims of Sweden and Finland had been considered.

II. ESTHONIA: **1180.**
A. **Physiography:** Low flat land with numerous lakes, rivers, and swamps.
B. **Climate:** Long cold winters and hot summers.
C. **Resources and Products:** Agriculture (rye, wheat, barley, and potatoes); live stock (sheep, cattle, hogs, and horses).
D. **Area, about 20,000 square miles; Population, about 1,400,000.**
E. **Capital and Chief City: Tallinn (Reval) 1180.**

III. LATVIA: **1969.**
A. **Physiography:** Wooded hills and valleys and low marshes; Duna or Dvina River flows across Latvia and empties into Gulf of Riga (3020).
B. **Climate:** Similar to that of Esthonia.
C. **Resources and Products:** Agriculture (rye, oats, barley, flax, and potatoes); timber and timber products; water-power from Duna River.
D. **Area, about 25,000 square miles; Population, about 1,850,000.**
E. **Capital and Chief City: Riga 3019.**

IV. LITHUANIA: **2030.**
A. **Physiography:** Plains, forest lands, and marshes; Niemen River on southern boundary.
B. **Climate:** Similar to that of Esthonia and Latvia.
C. **Resources and Products:** Timber and timber products; stock raising and dairy products (cattle, poultry, butter and eggs, hides and wool); agriculture (rye, oats, barley, wheat, potatoes, and flax).
D. **Area, about 19,000 square miles; Population, about 2,500,000.**
E. **Capital and Chief City: Kovno** (Memel, formerly in East Prussia, was awarded to Lithuania as its seaport by the allies' council of ambassadors in 1923).

Poland

THE lack of natural boundaries has been in great measure responsible for the historic misfortunes of Poland and for many of its present problems. From its earliest existence as a separate nation, Poland was constantly involved in disputes with its neighbors over this or that piece of territory, and the area of the country waxed and waned in accord with the power or weakness of its rulers. Lying in the middle of the Great European Plain at the crossroads of commerce between the north and the south, the east and the west, Poland has always been a storm center of international politics. Its location at the meeting point of diverse racial groups—Germanic, Scandinavian, Slavic, and Mongolian peoples — has been a further cause for unrest and dissension. All these things culminated in the complete overthrow of Polish sovereignty and the partition of Polish territory between Russia, Germany, and Austria in the years 1772, 1793, and 1795. As a result of the World War, however, Poland was restored as an independent nation. But the old problems, economic as well as political and social, remain to a great degree, and must be kept in mind while studying Poland's modern geographical status and the part this reëstablished nation plays in international affairs.

I. PHYSIOGRAPHY: **2857.**
A. **Part of Great Central Lowland of Europe: 1190-1.**
B. **Much of Land is Marshy and Dotted with Lakes: 2857.**
C. **Carpathian Mountains on Southern Boundary: 646.**
D. **Vistula River and Its Tributaries Drain Most of Poland: 3651.**
E. **Poland Has Short Coastline on Baltic in Northwest: 2856.**

II. CLIMATE: **2857.** Winters are long; springs are rainy; summers are dry and often extremely hot. The first suggestions of Russia's "continental" climate (3086) begin to show themselves here.

III. RESOURCES AND PRODUCTS: **2857.**
A. **Agriculture: Rye, Oats, Wheat, Barley, Sugar Beets, Potatoes, Hemp, and Hops.**
B. **Minerals and Mining: Coal, Iron, Zinc, Tin, Copper, and Sulphur.**
C. **Manufacturing: Textiles, Leather and Leather Goods, Lumber and Wood Products, Metal Products, Beet Sugar.**

IV. CHIEF CITIES: Warsaw (capital) **3673;** Lodz **2857;** Lemberg **2857;** Cracow **914.**

FREE CITY OF DANZIG: **962.** This important seaport and the surrounding territory, lying across the mouth of the Vistula River between Poland and East Prussia, was claimed by Poland after the World War as necessary to its commercial development. The population, however, is almost entirely German. To protect the rights of the Danzig citizens as well as the commerce of Poland, it was set up as an independent commonwealth under the protection of the League of Nations. **Area of Danzig and attached territory, 729 square miles; population, 390,000.** Besides its shipping interests, Danzig has many manufacturing industries.

Austria, Czecho-Slovakia, Hungary, Rumania

THESE four countries are called for convenience the Central European States. The first three came into separate existence as a result of the World War, having formerly been a part of the empire of Austria-Hungary. With Switzerland, they are the only important European states which have no outlet to the sea. This, as well as their mutual proximity and their joint history, makes it advisable to consider these three countries in a group. Rumania, with its front door upon the Black Sea, is not so closely related to the other Central European States. Politically, it has figured more prominently in the affairs of Russia and the Balkan States. Yet the natural resources of Rumania and its economic problems are very much the same as those of Hungary, Czecho-Slovakia, and Austria. All four countries lie, in whole or in part, in the great Danube Basin. Controlling the Central Mountains and Highlands which surround the Hungarian Plain, they thus control many of the most important avenues of commerce between northern and southern Europe. With friendly coöperation, they can develop their vast natural resources to the great advantage of all the regions involved. The greatest obstacle to such united effort is the extraordinary diversity of the population of these four nations. The Austrians are mostly of German Stock. The inhabitants of Czecho-Slovakia belong to the Bohemian (Czech) and the Slovak branches of the Slavic family. The majority of the people of Hungary are Magyars, that is descendants from early invaders of the Mongolian or Yellow race. The Rumanians are believed to be, in part at least, of Latin origin, with mixtures of Slavic blood. With each racial group having its own language, traditions, and strongly developed national aspirations, Central Europe is beset with many great problems in the adjustment of conflicting claims and interests.

- **I. AUSTRIA: 269, 270.**
  - **A. Physiography:**
    - **a. Alps in Western, Central, and Southern Austria: 101–2, 270, 3573.**
    - **b. Moravian Hills in the North: 270.**
    - **c. Valley of Danube between the Highlands: 961, 270.**
    - **d. Strip of Hungarian Plain in the East: 269, 271.**
  - **B. Climate:** The varying altitude of Austria produces a varied climate. The rainfall is heavy, particularly in the mountain districts.
  - **C. Resources and Products: 269.**
    - **a. Agriculture is the Chief Industry: Wheat, Rye, Barley, Oats, Potatoes, and Turnips.**
    - **b. Timber and Timber Products.**
    - **c. Minerals and Mining: Iron, Lignite Coal, Copper, Zinc, and Lead.**
    - **d. Manufacturing: Textiles, Automobiles, Pianos.**
  - **D. Area, about 32,000 square miles; Population, about 6,550,000.**
  - **E. Chief Cities: Vienna (capital) 3641; Grätz (see Fact-Index).**
- **II. CZECHO-SLOVAKIA: 947.** Made up of the former Austrian provinces of Bohemia (447), Moravia, Slovakia, and Ruthenia (948).
  - **A. Physiography:**
    - **a. Mountains and Highlands: Moravian Hills 270; Bohemian Forest (Böhmer Wald), Ore Mountains (Erzgebirge), and Giant Mountains (Riesengebirge of Sudetic Chain) 270, 1107, 447; Carpathian Mountains 646.**
    - **b. Rivers: Headwaters of Elbe 1107; Danube on Southern Boundary and Tributaries of Danube in the East 961.**
  - **B. Climate:** Abundant rainfall; cold winters and hot summers.
  - **C. Resources and Products: 947.**
    - **a. Timber and Timber Products: 646–7.**
    - **b. Agriculture: Wheat, Rye, Barley, Oats, Potatoes, Beets, Hops.**
    - **c. Minerals and Mining: Coal, Iron, Graphite, Gold, Silver, Copper, Lead 947, 647.**
    - **d. Manufacturing: Textiles, Glass, Furniture, Machinery, Paper, Chemicals, Beet Sugar, and Beer, 270.**
  - **D. Area, about 54,200 square miles; Population, about 13,600,000.**
  - **E. Capital and Chief City: Prague 2911.**
- **III. HUNGARY: 1702, 271.**
  - **A. Physiography:**
    - **a. Slopes of Carpathians Form Northern Boundary: 646.**
    - **b. Great Hungarian Plain (Alföld) Covers Remainder of Hungary and Extends Eastward into Rumania and Southward into Jugo-Slavia: 271, 1702, 1190.**
    - **c. Chief Rivers: Danube Flowing across Central Hungary 961; Theiss (or Tisza) in the East 962, 1702; Drave on the Southern Boundary 962, 1703.**
  - **B. Climate:** Hungarian Plain has less moisture than surrounding highlands, but rainfall is most abundant in the late spring which favors the early growth of crops, while the late summer is hot and dry, which helps the crops to ripen; the winters are extremely cold.
  - **C. Resources and Products: 1702–3, 271.**
    - **a. Agriculture:** The Hungarian Plain is the richest agricultural region in Europe.
      —Chief Crops: Wheat, Rye, Barley, Oats, Corn, Sugar Beets, Hops, Grapes, Tobacco, Flax.

- b. Stock Growing and Dairying.
- c. Minerals and Mining: Coal and Iron.

D. Area, about 36,500 square miles; Population, about 7,850,000.
E. Chief Cities: Budapest (capital) 524; Szegedin (see Fact-Index).

IV. RUMANIA: 3080.

- A. Physiography: See map, page 308.
    - a. Mountains: Southern Spurs of Carpathian Mountains Including Transylvanian Alps 646, 3081.
    - b. Uplands of Transylvania West of Mountains: 3081.
    - c. Strip of Hungarian Plain on Western Border.
    - d. Lowland Plain in East and South Comprising Lower Danube Basin and Stretching to Black Sea: 3081. This is the southwestern tip of the Russian Plain, which forms a part of the Great Central Lowland of Europe (1190–1).
    - e. Rivers: Danube (961) and Its Tributaries the Pruth and Sereth (308 map); Dniester on Northern Boundary (see Fact-Index).
- B. Climate: Mountains and western slopes have typical Central European climate; eastern plains suffer from extremes of heat and cold (3081).
- C. Resources and Products: 3081.
    - a. Agriculture: Wheat, Rye, Barley, Oats, Corn, Beans, Potatoes, Sugar Beets, Tobacco, Grapes, and Fruit.
    - b. Timber and Timber Products: 3081–2.
    - c. Minerals and Mining: Coal, Salt, Silver, Iron, Lead, Copper, and Marble.
    - d. Important Oil Fields: 2755, 3081 (picture).
- D. Area, about 122,000 square miles; Population, about 17,400,000.
- E. Chief Cities: Bucharest (capital) 523; Kishinef (see Fact-Index); Jassy, Constantza, 3082.

LIECHTENSTEIN: 1194, see also Fact-Index. This principality, lying between Austria and Switzerland and formerly dependent upon Austria-Hungary, was given its independence in 1918. Area, 65 square miles; population, about 11,000; chief products—grain, wine, fruit, timber, and live stock.

Spain and Portugal

WHY is it that Spain and Portugal, with their wealth of minerals, their favorable situation for ocean commerce, and their past traditions of power and prosperity, are today so thinly populated and so backward in their commercial development? This is not the place to discuss the historical causes of the decline of Spain and Portugal, the loss of their colonies which once included all of South America, or their relapse into a secondary place in international affairs. But a partial answer to the problem may be found in the geographical conditions which prevail in these countries. The Iberian Peninsula, upon which Spain and Portugal are situated, is almost as much isolated from the rest of Europe as though it were an island. The formidable wall of the Pyrenees bars the only approach by land. The coastline (see map on page 3300) has very few natural harbors large enough to accommodate modern ships, and most of the rivers are rushing mountain streams unfit for navigation. The interior of the country consists chiefly of a high rough plateau, criss-crossed by ridges which interfere with transportation from one part of the peninsula to the other. Furthermore, the climate and soil of this interior plateau are not favorable to agriculture on a large scale. In former days when commercial and industrial life was equally simple everywhere, Spain and Portugal were able to keep pace with their neighbors, but in the modern economic struggle these many natural obstacles have been a serious block to progress. The future prosperity of the peninsula depends to a great extent upon the development of the immense mineral resources of these rugged mountains and upon the establishment of industries to make use of the raw materials so obtained. Of the two countries, Portugal has the more favorable climate and soil.

I. SPAIN: 3299.

- A. Physiography:
    - a. Mountains: Pyrenees 2940; Cantabrian Mountains, Sierra Nevada, Sierra Morena 3299 (table), 3300 (map).
    - b. Central Table-Land or Plateau: 3300.
    - c. Lowland Plains: 3299. These include the valley of the Ebro (3300 map), a narrow strip on the Gulf of Valencia (3302), and the valley of the Guadalquivir broadening out on the Gulf of Cadiz (3300 map).
    - d. Guadalquivir (3182) and Ebro (see Fact-Index) are the Only Navigable Streams.
    - e. Smooth Coastline with Few Natural Harbors: 3299.
    - f. Balearic Islands off the East Coast: 307.
- B. Climate: 3300, 3301, 3302. The rainfall on the Atlantic Coast is extremely heavy; it is lighter on the Mediterranean coast; and in many parts of the mountain-ringed interior, semi-desert conditions prevail. Extremes of heat and cold exist in the interior, but on the coast the temperature is usually milder.

- **C. Resources and Products: 3300–2, 2940.**
  - **a. Agriculture: Wheat, Barley, Oats, Rye, Corn, Beans, Peas, Sugar Beets, Grapes, Olives (2579), Oranges (2590), Lemons (1985), Flax, and Hemp.**
    - —Importance of Irrigation: 3302, 3614.
  - **b. Stock Raising: Sheep, Goats, Hogs, Poultry, Cattle, Horses, Mules, and Asses.**
  - **c. Minerals and Mining: Coal, Iron (1820), Lead, Copper, Mercury (2200, 3302), Zinc, Sulphur, Silver (3242), Potash (2900).**
  - **d. Fisheries: Sardines 3126; Tunny 3552.**
  - **e. Manufacturing: Cotton Goods, Woolens, Silk, Wine, Leather, Paper, Glass, Cork, Lumber.**
  - **f. Supply of Water-Power is Large but Undeveloped: 3302.**
- **D. Chief Cities: Madrid (capital) 2110; Barcelona 329; Valencia 3614; Seville 3181.**
- **E. Spanish Possessions: Canary Islands 628; Spanish Morocco 2328; Rio de Oro and Rio Muni on West Coast of Africa (see Fact-Index).**

II. PORTUGAL: 2888.

- **A. Physiography:** The physiography of Portugal is generally similar to that of Spain, except that its mountain ranges are smaller. It is made up of a continuation of the great Iberian plateau, with several small lowland areas on the coast. Its principal rivers are the **Douro (2888)** and the **Tagus (2026)**, both navigable.
- **B. Climate:** Being more exposed to the tempering winds of the Atlantic, Portugal has on the whole a milder and moister climate than Spain.
- **C. Resources and Products: 2888–9.**
  - **a. Agriculture: Wheat, Corn, Oats, Rye, Barley, Grapes, Olives, Figs, Tomatoes, Oranges, Onions, and Potatoes.**
  - **b. Stock Raising: Sheep, Goats, Cattle, Hogs.**
  - **c. Forests: Lumber and Cork (887) are Among the Chief Sources of Wealth.**
  - **d. Minerals: Tungsten (3548), Iron, Copper, Manganese, Lead, Tin, and Gold.**
  - **e. Fisheries: Sardines 3126; Tunny 3552.**
  - **f. Manufacturing: Wine, Chemicals, Leather, Olive Oil, Woolens, Cotton Goods, Lace, Porcelain Tiles.**
- **D. Chief Cities: Lisbon (capital) 2026: Oporto 2888.**
- **E. Portuguese Possessions:**
  - **a. Atlantic Islands: Azores 288; Madeira 2106; Cape Verde Islands 641; St. Thomas and Principe (see Fact-Index).**
  - **b. African Colonies: Portuguese Guinea, Angola, and Mozambique (see Fact-Index).**
  - **c. Asiatic and East Indian Colonies: Portuguese India (including Gôa, Damao, and Diu) 1756; Macao (see Fact-Index); part of Timor Island (see Fact-Index).**

ANDORRA: 1194, see also Fact-Index. This tiny semi-independent republic lies in the Pyrenees between Spain and France. Area, 191 square miles; population, 5000.

Italy

ITALY, with its commanding position in the Mediterranean Sea, dominated the world in the days when the Mediterranean was the center of civilization. After the break-up of the Roman Empire, Italy retained its leadership in culture and continued to be prosperous, despite the fact that political supremacy passed to northern Europe. So great was the natural wealth of this fertile peninsula and so versatile the genius of its people, that it became in the Middle Ages and later the home of numerous city-states and principalities, many of which continued to thrive despite intrigue, civil war, and foreign invasions until Italy became a unified nation in the 19th century. The commercial advantages which Italy owes to its position along the highways of trade between Europe, Africa, and Asia promise to become increasingly important as the resources of the near-East and the north African lands are more fully developed.

I. PHYSIOGRAPHY:

- **A. Mountains: 1835.**
  - **a. Alps along the Northern Boundary: 101.**
  - **b. Apennines Form Backbone of Peninsula: 154.**
    - **1.** Highlands of Sicily (3229) are part of same land formation as the Apennines.
    - **2.** Volcanoes: Vesuvius 3635; Etna 1185.
- **B. Lowlands: 1835, 2047, 2848.** These include the plains of Lombardy and the valley of the Po, the plains of Tuscany, the Roman Campagna, and other coastal plains along the Mediterranean Sea (2193) and the Adriatic Sea (26).
- **C. Chief Rivers: Po River 2848; Tiber 3494; Adige and Arno 1835 (see also Fact-Index).**
- **D. Principal Lakes: Maggiore 1835 (picture); Como 1841 (picture).**
- **E. Islands: Sicily 3229; Sardinia 3126.**

II. CLIMATE: 1835. The Alps cut off the cold winds from the north, making the valleys on the Italian side warmer than those on the other slope. The summers are hot throughout the entire peninsula. Except in the higher mountain regions, the winters become increasingly mild toward the south. Rainfall is usually plentiful in all parts of Italy.

III. NATURAL RESOURCES:
  A. **Soil and Forests: 1840, 1190, 2047, 3126.**
  B. **Minerals:** With the exception of Marble (2145, 154), the mainland of Italy contains little mineral wealth. However, Sardinia (3126) provides many metals, principally Iron, Zinc, and Lead, and Sicily yields Sulphur (3230, 3389).
  C. **Water-Power: 1840; Fish and Other Water Products 2194, 2848.**

IV. INDUSTRIES: **1840–1, 3230, 3126.**
  A. **Agriculture: Wheat, Corn, Potatoes, Sugar Beets, Grapes, Olives, Oats, Beans, Rice, Barley, Rye, Lemons, Oranges, and Tomatoes.**
  B. **Stock Raising: Sheep, Cattle, Goats, Hogs, Horses, Mules, and Asses.**
  C. **Mining and Quarrying: Sulphur, Marble, Iron, Zinc, Lead, Mercury, and Manganese.**
  D. **Fisheries: Tunny 3552; Sardines 3126; Coral 886.**
  E. **Manufacturing: Silk, Cotton Goods, Rayon, Wines, Olive Oil, Hemp, Hats, Rubber Goods, Leather, Automobiles, Glass, Paper, Chemicals, Sugar, Macaroni, and Soap.**

V. CHIEF CITIES: **Naples 2390; Milan 2235; Rome (capital) 3049; Turin 3555; Palermo (see Fact-Index); Genoa 1412; Florence 1293; Trieste 3540; Catania (see Fact-Index); Bologna 450; Venice 3623; Ravenna 2979; Pisa 2810; Trent 3539.**

VI. ITALIAN POSSESSIONS: **Tripoli or Libya 3541; Eritrea and Italian Somaliland (see Fact-Index); the Island of Rhodes 3010.**

SAN MARINO: 1842. This is a small independent republic completely surrounded by Italian territory.

FIUME: 1286. After a dispute in 1920 between Italy and Jugo-Slavia over this important seaport, it was made into a separate state. Area, about 8 square miles.

Jugo-Slavia, Bulgaria, Albania, Greece

OCCUPYING, as they do, the Balkan Peninsula (307) and adjacent territory, these four countries are known as the Balkan States. The history of this corner of Europe has been one of disorder, strife, intrigue, and confusion. After more than three hundred years spent under the yoke of the Turks, the Balkan peoples began to gain their freedom about a century ago, only to become involved in a series of wars, during which the jealousies and rivalries of the greater powers were aroused, culminating directly in the world disaster of 1914–1918. Much of this tragic course of events can be explained in geographical terms. Lying on the pathway between Europe and Asia, and between the Mediterranean lands and the great plains to the northeast, this region has been overrun by invaders of widely varying races ever since the dawn of history. Each left a separate heritage in the population. The numerous small mountain ranges which cut up the surface of the peninsula as well as the many separate outlets to the sea tended to keep this population divided into small independent groups, each with its own customs, dialect, and ambitions. The long Turkish rule not only failed to unite the interests of these people, but actually held back their civilization at the very time when the rest of Europe was learning the lesson of modern organization and government. The rapid development of the commerce of the near-East places the Balkan States today in a position of critical importance, and the many phases of the "Balkan question" are among the most delicate of international affairs.

I. JUGO-SLAVIA: **1901.** This state, newly-created after the World War, consists of what formerly was **Serbia (3176)**, **Montenegro (2313)**, **Bosnia and Herzegovina (468)**, and other lands on the Adriatic previously belonging to Austria-Hungary, including **Croatia and Slavonia (271)**, and most of **Dalmatia (1286)**. The northern boundary extends into the **Hungarian Plain (1702)**.
  A. **Physiography: 1902, 2313, 307, 308 (map).**
    a. **Mountains:** All of Jugo-Slavia, except the northern strip of Hungarian plain is covered with rugged forested highlands and mountains including the **Dinaric Alps**, which form a link between the Alps proper in the west and the Balkan ranges in the east (1190).
    b. **Lowlands:** The strip of **Hungarian Plain** includes the valleys of the **Save** and the **Drave** and a rich part of the **Danube Valley (962)**.
  B. **Climate:** The climate, particularly on the southern mountain slopes, is mild. Extremes of cold are found only in the highest interior ranges. Rainfall is plentiful along the coast and in the foothills to the north, but scanty in some of the enclosed table-lands.
  C. **Resources and Products: 1902, 3177, 468.**
    a. **Agriculture: Wheat, Barley, Oats, Corn, Potatoes, Grapes, Rye, Sugar Beets, Hops, Tobacco, Fruits (particularly Plums), and Hay.**
    b. **Stock Raising: Sheep, Goats, and Cattle.**
    c. **Minerals and Mining: Coal, Iron, Copper, Lead, Zinc, Antimony, Manganese, Mercury, Gold, Silver, and Cement.**
    d. **Manufacturing: Flour, Beer, Silk, Wines, Leather, Textiles, Carpets, Meat-Packing, Pottery, Iron Products, and Lumber.**
  D. **Area, about 96,000 square miles; population, over 12,025,000.**
  E. **Chief Cities: Belgrade (capital) 376; Agram or Zagreb (see Fact-Index).**

II. BULGARIA: 532.

  A. Physiography: **532–3, 307.** The **Balkan Mountains** lie across the middle of Bulgaria from west to east. To the north is a lowland plain extending to the boundary which is mostly formed by the **Danube River (962)**. South of the Balkan Mountains are highlands surrounding a strip of plain which extends to the Black Sea (**434**).
  B. Climate: Generally mild with cold winters in the mountains of the interior.
  C. Resources and Products: **533.**
    a. Agriculture: Wheat, Corn, Barley, Rye, Tobacco, Grapes, and Fruit.
    b. Stock Raising: Sheep, Cattle, and Goats.
    c. Minerals and Mining: Coal, Iron, Gold, Silver, Lead, Manganese, and Copper.
    d. Manufacturing: Foodstuffs, Leather, Perfumes.
  D. Area, about 40,000 square miles; Population, about 4,500,000.
  E. Chief Cities: Sofia (capital) **3272**; Philippopolis (see Fact-Index).

III. ALBANIA: 79.

  A. Physiography: **79.** Rugged mountains encircle a narrow strip of coastal plain on the Adriatic.
  B. Climate: Extremely mild, except in the highest mountain regions where the winters are quite severe.
  C. Resources and Products:
    a. Agriculture: Wheat, Corn, Tobacco, Olives.
    b. Stock Raising: Sheep, Goats, and Cattle.
    c. Minerals: Coal, Copper, Silver, Gold, and Lead.
    d. Manufacturing: Except olive oil and cloth for home use, there are no manufactures of importance in Albania.
  D. Area, about 11,000 square miles; Population, about 850,000.
  E. Chief Cities: Durazzo, Tirana (capital), and Scutari (see Fact-Index).

IV. GREECE: 1517.

  A. Physiography:
    a. Mountains and Plains: **1517.** All of Greece is criss-crossed by ranges of low mountains and hills, with small valleys and plains between. The **Pindus range (307)** extending down from the northwest border is the most important of the mountain systems.
    b. Coastline: **1517.** Marked by countless gulfs and peninsulas, among which the most important are the **Gulf of Corinth (886)** and the **Peninsula of Morea (1517)**.
    c. Surrounding Islands: Crete **918**; Aegean Islands (Sporades and Cyclades) **1520, 308** (map); Ionian Islands **308** (map).
  B. Climate: **1518.** Temperate, with moist winters and dry summers.
  C. Resources and Products: **1517–8, 1528, 918.**
    a. Agriculture: Wheat, Corn, Barley, Grapes, Currants, Olives, Oats, Tobacco, Cotton, Oranges, Lemons, Rice, Figs, and Nuts.
    b. Stock Raising and Dairy Products: Sheep, Cattle, Cheese.
    c. Minerals and Mining: Greece is poor in minerals particularly Coal; the most important are **Iron** and Zinc.
    d. Manufacturing: Olive Oil, Wines, Textiles, Leather, Soap, Glass, and Paper.
    e. Shipbuilding and Sea Commerce are Important: **1528.**
  D. Area, 49,900 square miles; Population, about 5,000,000.
  E. Chief Cities: Athens (capital) **249**; Saloniki **3114**; Piraeus (port of Athens) **249**.

TURKEY IN EUROPE: Of its former possessions in Europe, Turkey retains control only of **Constantinople (871)** with Chatalja and Eastern Thrace, totaling about 11,000 square miles. On each side of the **Bosporus (468)**, of the Sea of Marmora, and of the **Dardanelles (963)**, territory has been set aside, called the **"Zone of the Straits,"** under the control of an Inter-Allied Commission.

Russia

RUSSIA, the last of the European states to come under the influence of western civilization, still remains almost a stranger among the others. Indeed, Russia belongs as much to Asia as it does to Europe. The ambitions of its former rulers led them to seek a place in the affairs of the western powers, but fundamentally Russia continued to be a nation apart. When the revolution of 1917 overthrew the czar and the whole structure of the imperial government, the bonds with western Europe were broken, and Russia retired within itself, faced with the enormous problem of rebuilding a government from the very foundation upward. The mass of the Russian people, made up of varying types of Slavs, mingled with Tatars, Mongols, and numerous other stocks, had little spirit of unity and no experience with the broad problems of self-government. Yet the radical Bolshevist leaders (450, 3095) who had taken control chose this moment for launching an experiment in mass-rule such as had never before been attempted. What the ultimate result of this experiment will be, it is impossible to forecast. Disorder, anarchy, famine, and the tyranny of dictators marked the opening days of Bolshevism. Other great nations either held aloof or opposed the new régime. But Russia is such a vast country with such enormous natural resources that under proper management it has the power to stand alone. Whether a government founded on Bolshevist principles can work out its great economic problems remains to be seen. This Outline deals only with European Russia. The far larger but less densely populated regions of Asiatic Russia are treated in the Outline on Asia.

I. PHYSIOGRAPHY:

- A. **Most of Russia is a Great Lowland Plain: 3085, 3086, 1190–1.**
  - a. **The Fertile "Black Belt": 3575, 3086.**
  - b. **Steppes or Prairie Lands and Barren Tundras: 1190–1, 3084, 3086.**
- B. **Mountains:**
  - a. **Low Chain of Ural Mountains on Eastern Boundary of Europe: 3606, 1190.**
  - b. **Rugged Caucasus Mountains on Southern Boundary: 663, 1190, 3091 (picture).**
- C. **Rivers, Lakes, and Inland Seas: 3085, 1188, 434, 654, 3575.**
  - a. **Volga River, the Largest Stream in Europe: 3660.**
  - b. **Lake Ladoga, the Largest Lake in Europe: 1955.**
  - c. **Black Sea: 434; Caspian Sea: 654.**

II. **CLIMATE: 3086, 2973.** The great interior plains of Russia have much the same climate as the North American plains, namely a wide variation in temperature between winter and summer, dry winds, and uncertain rainfall. Like the North American plains, also, the Russian plains extend from the frozen Arctic Zone to the temperate regions of the south.

III. RESOURCES AND PRODUCTS:

- A. **Agriculture and Stock Raising: 3086, 922.**
  - a. **Great Areas of Extremely Fertile Soil: 3086, 3575.**
  - b. **Chief Crops: Wheat (3732), Rye, Oats, Barley, Potatoes, Flax (1292), Hemp, Sugar Beets, Tobacco, and Rice.**
  - c. **Live Stock: Sheep, Cattle, Horses, Hogs.**
- B. **Forests and Timber Products: 3086, 3607.**
  - **—Lumber, Wood Pulp, Tar, Turpentine, and Resin.**
- C. **Fish and Fisheries: 3086, 654.** Chief products of Fisheries are **Salmon** and **Sturgeon (3374)**, the latter yielding **Caviar** and **Isinglass.**
- D. **Minerals and Mining: 3086–7, 3575, 654, 664, 3606.**
  - a. **Russia is the Chief Source of Platinum: 2831.**
  - b. **Other Minerals: Coal, Petroleum, Iron, Manganese, Cobalt, Sulphur, Mercury or Quicksilver, Copper, Zinc, Gold, Silver, Iridium, and Precious Stones.**
- E. **Manufacturing: 3086, 922.** Among the principal manufactures in normal times are **Iron Products, Machinery, Cement, Textiles, Chemicals, Paper, Sugar, and Shoes.**

IV. TRADE AND TRANSPORTATION:

- A. **Access to Ocean Highways is Difficult: 3085.**
- B. **River and Canal Transportation: 3085–6, 3660, 1955.**
- C. **Importance of Black Sea and Caspian: 434, 654.**
- D. **Railroads:** There are about 30,000 miles of railway in operation in European Russia.

V. **DIVISIONS OF RUSSIA:** The old Russian Empire has fallen into many divisions, of which some are completely independent, others more or less closely bound to the Russian Soviet Republic. Finland, Esthonia, Latvia, Lithuania, and Poland are among the independent states, and are treated in a separate Outline (3907–8). The Republic of **Ukraine (3575)** is largely controlled by the Russian Soviet and has been treated in this Outline as a definite part of Russia. The same is true of **Crimea (921).** The Caucasian Soviet Republics of **Georgia (1434), Azerbaijan (see Fact-Index), and Armenia (211),** lying partly in Europe and partly in Asia, are treated under Asiatic Russia.

VI. **CHIEF CITIES OF EUROPEAN RUSSIA: Leningrad 2747; Moscow (capital) 2330; Odessa 2560; Kief 1922; Astrakhan 237.**

AFRICA

AFRICA is the second in size of the continents, ranking next to Asia. It has been known to civilized people ever since the days of the ancient Egyptians. Yet it is today the most backward in civilization. Several important geographical causes contributed to retard the exploration and development of Africa. Across the northern half lies the Sahara, the largest desert in the world, which cut off the ancient seats of civilization on the Mediterranean from the African interior. The coast of Africa contains very few natural harbors, and the coastal plains are narrow, usually walled off from the great interior tableland by chains of hills or rugged mountains. Few rivers break through this encircling wall, and of these only a bare half-dozen are navigable even to small craft. But if the approach to Africa was difficult, the obstacles encountered upon landing were even more formidable. By far the greater part of the continent lies in the tropics, and in addition to the oppressive heat, a host of tropical diseases beset the white man. The negro population of the interior lived in a state of primitive savagery. There was no ready-made civilization or organization in states such as existed in Asia with which white men could deal, or upon which they could build. They had not only to fight the natives for a foothold, but to bring peace between the countless warring tribes, and teach the reluctant tribesmen their first lesson in government. Territorial rivalries between the European nations themselves further complicated the problem, so that the task of developing the natural wealth of the Dark Continent for the benefit of our civilization has only just commenced.

I. POSITION AND AREA:
- A. **Africa extends an equal distance north and south of the Equator. Thus the temperate region in the extreme north is matched by a temperate region in the extreme south; the Sahara Desert has a smaller counterpart in the Kalahari Desert; the Sudan grasslands of the north are repeated in the South African prairie belt; while in the center the Equator splits the tropical forest in two.**
- B. **With its area of 11,262,000 square miles, Africa is about three times as large as Europe and contains one-fifth of all the land surface of the globe.**

II. PHYSIOGRAPHY: See map facing page 40.
- A. **The Great Mass of Africa Consists of a High Table-land Surrounded by Narrow Coastal Plains: 33.**
- B. **Former Land Connection with Europe and Asia: 3299, 2106.**
- C. **Mountains and Highlands:** Most of the higher mountain ranges are on or near the sea coast.
  - a. **Atlas Mountains in the Northwest: 33, 2328, 97.**
  - b. **Highlands of the East:** These include the **Table-land of Nubia (2986)**, the **Abyssinian Mountains (3, 2986)**, and the **East African Ranges (34, 36, 1069 map)**. The latter, mostly of volcanic origin, contain **Kilimanjaro**, the highest peak on the continent, the **"Great Rift Valley," and Ruwenzori Mountain.**
  - c. **South African Highlands: 36, 3279, 3282 (map).**
- D. **Lowlands: Congo Lowland 858–9: Narrow Coastal Lowlands 33.**
- E. Forests, Grasslands, and Deserts:
  - a. **Great Forests of Central Africa: 34, 858.**
  - b. **Savanna Region of the Sudan North of the Great Forest: 34, 3384.**
  - c. **Veldt Region to the South: 34, 36, 3279.**
  - d. **Sahara Desert, the Largest Arid Waste in the World: 3104.**
    - **—The Libyan Desert, the Nubian Desert, and the Arabian Desert are eastern continuations of the Sahara: 3542, 1092–3, 1095 (map).**
  - e. **Kalahari Desert in South Africa: 36, 3280.**
- F. Chief Rivers and Lakes:
  - a. **Nile River, the Only Large African River Flowing into the Mediterranean: 2509.**
  - b. **Congo River and Its Vast Basin: 858.**
  - c. **Niger River: 2507; Zambezi River and Victoria Falls: 3837, 3640.**
  - d. **Lake Chad: 34; Victoria Nyanza 3641, 2510; Lake Tanganyika 3432; Lake Albert, Lake Albert Edward, and Lake Nyasa: 36, 1069 (map).**
- G. Coastline is Unbroken—Few Natural Harbors: 33, 1578.
  - **—Mediterranean Coast 2194; Red Sea Coast 2986; Indian Ocean 1763; Atlantic Ocean 254; Cape of Good Hope 640.**
- H. Islands off the Coast of Africa:
  - a. **Madagascar, the Only Large Island: 2105, 36.**
  - b. **Small Islands in the Atlantic: Madeira Islands 2106; Canary Islands 628; Cape Verde Islands 641; Ascension 254; St. Helena (see Fact-Index).**
  - c. **Small Islands in the Indian Ocean: Zanzibar and Pemba 3837; Mauritius 2174; Comoro Islands, Reunion, and Seychelles (see Fact-Index).**

III. CLIMATE: 40.
- A. **Hot Equatorial Climate Modified in Places by Altitude: 34, 641, 1068.**
- B. **Climate of the Mediterranean Coast: 2328, 97, 1092.**
- C. **Desert Climate: 33, 3104, 795.**
- D. **Bracing Climate of South Africa: 3279, 641.**
- E. **Rainfall: 34, 40, 1092, see also map facing page 40.**
  - —Reasons for Lack of Rain in the Sahara Desert: 3104.

IV. MINERAL RESOURCES OF AFRICA:
- A. **In North Africa: Petroleum 2755, 2328, 97; Copper, Antimony 2328, 97; Iron, Lead 2328, 3550, 97; Zinc 3550, 97; Sulphur, Silver, Gold 2328; Manganese, Phosphates 3550; Mercury 97.**
- B. **In East Africa: Coal, Iron, Lead, Copper 1069.**
- C. **In South Africa: Gold 41, 1479, 1895, 3283, 3527; Diamonds 1001-2, 1003 (picture), 2590, 3527; Copper 41, 881, 3527; Coal 812, 2398, 2590, 3527; Iron 3527; Tin 3504; Lead, Silver 3527.**

V. VEGETABLE AND ANIMAL LIFE:
- A. **Typical Vegetation of Africa:** Monkey-bread Tree or Baobab 34; Mangrove 2135; Cork Oak 887; Myrtle 2385; Ebony 1073; Mahogany 2125; Cypress 946; Acacia 4; Mimosa 3174; Orange 2588; Olive 2579; Lemon Tree 3542; Tamarind 3432; Fig 97, 3542; Cycad 3533; Castor Oil Plant 657; Papaw 1378; Lotus 2063; Papyrus Plant 2674; Wild Coffee Plant 820; Elephant Grass 34; Date Palm 966; Oil Palm 2647, 1227; Bamboo Palm 323; Ground-nut 2701, 859; Banana 324.
- B. **Typical Animals of Africa:** Hyena 1711; Jackal 1855; Aardwolf 34; Leopard 1988; Lion 2024; Caracal 2087 (picture); Elephant 1126; Hippopotamus 1651; Rhinoceros 3006; Monkey 2291–2; Baboon and Mandrill 2292; Chimpanzee 738; Gorilla 1491; Buffalo 527; Camel 590; Giraffe, Okapi 1464; Wild Ass

236; Zebra 3838; Eland, Springbok, Gnu 146; Roan Antelope, Red Waterbuck: 147, pictures; Hartbeest 34, Wart Hog 1671, picture, 397; Wild Boar 440; Crocodile 923; Chameleon 686; Lizard 2037; Cobra 816; Horned Viper 3647; Mudfish 2363, 1272; Ostrich 2603; Whale-headed Stork 3363, picture; Secretary Bird 3171; Parrot 2690; Raven 2979; Weaver Bird 3710; Framolin and Guinea-Fowl 1548; Tsetse Fly 3546; White Ants or Termites 142.

VI. MANKIND IN AFRICA:
- A. Early Civilization in North Africa: **32.**
  - **a. The Story of Ancient Egypt: 1098.**
  - **b. The Phoenicians and the Founding of Carthage: 2773, 650, 3549.**
  - **c. Greek Settlements in Cyrenaica: 3541.**
  - **d. Roman Conquest of North Africa: 3045–6, 651, 1107, 3549.**
  - **e. Early Christian Church in Africa: 3541, 3549, 3.**
  - **f. Invasion and Conquest by the Vandals: 3617.**
  - **g. Conquest of North Africa by the Mohammedans: 2276, 2278, 3550, 3541.**
- B. Exploration and Colonization by Whites: **36.**
  - **a. Work of Prince Henry the Navigator: 1638.**
  - **b. Bartholomew Diaz Discovers the Cape of Good Hope: 640, 3279.**
  - **c. Vasco da Gama Sails around Africa to the Indies: 1392.**
  - **d. The Dutch Settle Cape Town: 3279, 640.**
  - **e. Struggle between British and Boers: 3280–2, 3526, 446.**
  - **f. Two Great Explorers—David Livingstone and Henry M. Stanley: 2033, 3338.**
  - **g. Cecil Rhodes—British Empire Builder: 3011.**
  - **h. European Powers Divide Africa: 40.**
- C. Native Races of Africa:
  - **a. Black Peoples:**
    1. Negrito Types: Equatorial Pigmies 38; Bushmen and Hottentots 37, 3280.
    2. True Negro Type: 2434, 37, 35.
    3. Negroid or Bantu Type: 37, 2434, 38 (picture).
  - **b. White Peoples:**
    1. Hamitic Types: Berbers 2323; Tuaregs 33; Copts and Fellahin 1094, 1096; Kabyles, Masai, Gallas, Somalis 37.
    2. Semitic Types: Arabs 232; Bedouins 165.
  - **c. Brown Peoples:** Hovas and Malagasies of Madagascar 2105, 2106.
- **D. Distribution of Population:** See map on page 40, and map facing page 40.

Divisions of Africa

I. NORTHERN AFRICA:
- A. Egypt: **1092** (Independent under British Supervision).
  - **a. Area, about 350,000 square miles; Population, about 13,000,000.**
  - **b. Chief Products:** Cotton 904; Wheat, Barley 1096; Corn 891; Millet 2239; Rice 3015; Sugar 3385; Clover 810; Petroleum 2755; Cotton and Silk Goods, Morocco Leather, Pottery 1097.
  - **c. Chief Cities: Cairo 566; Alexandria 87; Port Said 3384; Tanta 1096; Assiut 1094; Suez 3384; Damietta 1096.**
- B. Anglo-Egyptian Sudan: **1092** (British).
  - **a. Area, about 1,000,000 square miles; Population, about 3,400,000.**
  - **b. Chief Products:** Gum Arabic 1552; Ivory 1853; Cotton, Ostrich Feathers, Palm Nuts, Dates, Sesame, Hides, Skins, and Gold 1093.
  - **c. Chief Cities: Khartum and Omdurman 1093.**
- C. Tripoli: **3541** (Italian).
  - **a. Area, about 406,000 square miles; Population, about 1,000,000.**
  - **b. Chief Products:** Dates, Olives, Lemons, Figs, Grapes, Cereals, Saffron, Almonds, Bananas, Barley, Cattle, Sponges.
  - **c. Chief Cities: Tripoli and Bengazi 3542.**
- D. Tunis: **3549** (French).
  - **a. Area, 50,000 square miles; Population, about 2,000,000.**
  - **b. Chief Products:** Olives, Wheat, Barley, Oats, Grapes, Dates, Almonds, Oranges, Lemons, Pistachios, Alfa Grass, Henna, Cork, Sheep, Goats, Cattle, Sardines, Tunny, Lead, Zinc, Iron, and Manganese.
  - **c. Chief Cities: Tunis 3549 (picture), Sfax, Susa, Kairwan 3550.**
- E. Algeria: **96** (French).
  - **a. Area, 222,180 square miles; Population, about 5,850,000.**
  - **b. Chief Products:** Wheat, Barley, Oats, Corn, Potatoes, Artichokes, Beans, Peas, Tomatoes, Flax, Silk, Tobacco, Wine, Tropical Fruits, Olive Oil, Cotton, Cork, Sheep, Goats, Cattle, Sardines, Tunny, Iron, Lead, Zinc, and Coal.
  - **c. Chief Cities: Algiers, Oran, Constantine 97.**
- F. Morocco: **2327** (French, Italian, and Neutral).
  - **a. Area: French Protectorate, 220,500 square miles; Spanish Morocco, 10,900 square miles; Tangier (neutral zone), 140 square miles; Total Population, about 6,000,000.**

b. **Chief Products:** Barley, Wheat, Beans, Oats, Corn, Linseed, Olives, Oranges, Lemons, Dates, Almonds, Figs, Sardines, Tunny, Sheep, Goats, Cattle, Horses, Iron, and Silver.

c. **Chief Cities: Morocco or Marakesh (see Fact-Index); Fez 2328; Tangier 2328** (picture).

G. **Rio de Oro and Adrar: see Fact-Index** (Spanish).

a. **Area, about 109,200 square miles; Population 30,000.**

b. **Products:** This colony is virtually desert land, without important products.

c. **Capital: Villa Cisneros.**

II. EASTERN AFRICA:

A. **Eritrea: see Fact-Index** (Italian). Area 45,800 square miles; population 450,000. Chief products: Live Stock, Meat, Hides, Butter, Pearls and Mother of Pearl, Vegetable Ivory, Salt, Gold. Chief cities: **Asmara, Massowah.**

B. **Somaliland: See Fact-Index.**

a. **Italian Somaliland:** Area, about 139,400 square miles; population 650,000. Chief industries: Cattle Raising, Agriculture. Chief city, **Mogadisho.**

b. **British Somaliland:** Area 68,000 square miles; population 300,000. Chief products: Skins, Hides, Gum, Resins, Cattle, Sheep. Chief city, **Berbera.**

c. **French Somaliland:** Area, about 5,790 square miles; population 208,000. Chief products: Coffee, Ivory, Hides, Skins, Salt. Chief city, **Djibouti.**

C. **Abyssinia: 3** (Independent).

a. **Area, about 350,000 square miles; Population 10,000,000.**

b. **Resources and Products:** Hides, Skins, Coffee, Wax, Ivory, Civet, Barley, Millet, Wheat, Tobacco, Iron, Gold, Coal, Silver, Sulphur, Timber, and Rubber.

c. **Chief City: Addis Abeba** (capital).

D. **British East Africa:**

a. **Kenya Colony: 1068.** Area, about 347,000 square miles; population 2,810,000. Resources and products: Rice, Coconuts, Cotton, Groundnuts, Cassava, Sugar Cane, Bananas, Wheat, Barley, Corn, Flax, Coffee, Sisal Hemp, Live Stock, Timber. Chief cities: **Mombasa, Nairobi** (capital).

b. **Uganda: 1068.** Area, about 110,300 square miles; population 3,300,000. Resources and products: Cotton, Coffee, Para Rubber, Cocoa, Oil-Seeds, Timber, Bananas, Ivory. Chief cities: **Entebbe** (British capital), **Buganda** (Native capital).

c. **Tanganyika Territory: 1069** (former German East Africa). Area, about 384,200 square miles; population 7,700,000. Resources and products: Coco-Palms, Coffee, Rubber, Sugar, Cotton, Tea, Cardamom, Sisal Hemp, Live Stock, and Timber. Chief city: **Dar-es-Salaam** (capital).

d. **Islands of Zanzibar and Pemba: 3837.** Area, about 1000 square miles; population, about 196,700. Products: Cloves, Coconuts (Copra), Hides, Pottery, Coir Fiber, Rope, Soap, Oil, Jewelry, Mats. Chief city: **Zanzibar.**

E. **Nyasaland: See Fact-Index** (British). Area, 39,600 square miles; population 1,204,000. Resources and products: Cotton, Tobacco, Coffee, Tea, Live Stock. Chief trade center, **Port Herald.**

F. **Mozambique or Portugese East Africa: 1069-70.**

a. **Area, about 428,150 square miles; Population 3,120,000.**

b. **Chief Products:** Sugar, Coconuts, Rubber, Bees-wax, Ivory, Gold, Coal.

c. **Chief Cities: Mozambique, Lourenço Marquez.**

III. WESTERN AFRICA: **33-4.** Products typical of Western Africa are Mahogany, Ebony, Ivory, Rubber, Groundnuts, Manioc, Yams, Gum, Palm Oil and Kernels, Dyewoods, Hides, Skins, Feathers.

A. **French West Africa and the Sahara:**

a. **Senegal: see Fact-Index.** Area, 74,112 square miles; population, 1,205,000. Chief cities: **St. Louis** (capital), **Daker.**

b. **French Guinea: see Fact-Index.** Area, 95,218 square miles; population, 1,580,000. Chief city, Konakry.

c. **Ivory Coast: see Fact-Index.** Area, 121,967 square miles; population, 1,407,000. Chief cities: **Bingerville** (capital), **Grand Bassam.**

d. **Dahomey: see Fact-Index.** Area, about 42,460 square miles; population, about 860,000. Chief city, **Porto Novo.**

e. **French Sudan: 3384.** Area, about 366,700 square miles; population, about 2,400,000. Chief cities: **Bamako** (capital), **Timbuktu.**

f. **Upper Volta:** Area, about 154,400 square miles; population about 3,000,000. Chief city, **Ouagadougou.**

g. **Togo: 40** (French share of former German Togoland). Area, about 21,200 square miles; population, about 500,000. Chief cities: **Lome, Anecho.**

h. **Mauritania** (population, 240,000) and **Territory of Niger** (population, 700,000); joint area, 694,800 square miles of desert land equally divided between the two districts.

B. **British West Africa:**

a. **Nigeria: see Fact-Index.** Area, about 332,000 square miles; population, about 17,500,000. Chief city, **Lagos.**

b. **Cameroon: see Fact-Index** (British portion of former German Cameroon). Area, about 30,000 square miles; population, about 400,000. Chief city, **Victoria.**

c. **Gambia:** see **Fact-Index.** Area, about 4,130 square miles; population, about 240,000. Chief city, **Bathurst.**
d. **Sierra Leone:** see **Fact-Index.** Area of **Colony,** about 4,000 square miles; population, about 76,000. Area of **Protectorate,** about 27,000 square miles; population, about 1,328,000. Chief city, **Freeport.**
e. **Gold Coast: 33** (includes part of former German Togoland). Area, about 80,000 square miles; population, about 1,506,000. Chief city, **Accra.**

C. **Spanish West Africa:** see **Fact-Index. Rio Muni:** area, 9,470 square miles; population, 200,000. **Fernando Po:** area, 780 square miles; population, about 25,000.

D. **Portugese Guinea:** see **Fact-Index.** Area, about 13,900 square miles; population, 289,000. Chief city, **Bolama.**

E. **Liberia: 1990** (independent Negro Republic under protection of United States). Area, about 43,000 square miles; population, about 2,000,000. Chief city, **Monrovia.**

IV. **MIDDLE AFRICA:**

A. **French Equatorial Africa: 33–4, 40.**
a. **Area, 1,037,100 square miles; Population, about 9,000,000.**
b. **Products and Resources:** Rubber, Palm Oil, Ivory, Coffee, Live Stock, Copper, Zinc, Lead, and wild forest products similar to those listed under West Africa.
c. **Chief Ports: Port Gentil, Libreville.**

B. **Cameroon:** see **Fact-Index** (French). Area, about 166,500 square miles; population, about 1,500,000. Chief products: Coffee, Tobacco, Palm Oil, Ivory.

C. **Congo State** (Belgian): **859.**
a. **Area, about 900,000 square miles; Population, about 11,000,000.**
b. **Products and Resources:** Rubber, Palm-nuts, Palm Oil, Cocoa, Ivory, Coffee, Rice, Cotton, Tobacco, Cattle, Gold, Diamonds, Copper, Coal, Iron, Tin, and Manganese.
c. **Chief Cities: Boma (capital), Leopoldville.**

D. **Angola:** see **Fact-Index** (Portuguese).
a. **Area, 484,800 square miles; Population 4,125,000.**
b. **Resources and Products:** Coffee, Rubber, Wax, Coconuts, Ivory, Fish, Tobacco, Petroleum, Asphalt, Copper, Iron, Salt, Gold.
c. **Chief Cities: Loanda (capital), Benguela.**

V. **SOUTH AFRICA: 3279** (British).

A. **Basutoland: 3283, 3282 (map).** Area, 11,716 square miles; population, about 405,000. Products and resources: Wool, Wheat, Corn, Kaffir Corn, Live Stock, Iron, Copper, Coal. Chief City: **Maseru** (capital).

B. **Bechuanaland: 3283, 3282 (map).** Area, about 275,000 square miles; population, about 126,000. Chief products: Cattle, Sheep, Goats, Corn, Kaffir Corn, Gold, Silver. Chief cities: **Francistown, Mafeking.**

C. **Rhodesia: 3282–3.**
a. **Area, about 440,000 square miles; Population, about 1,740,000.**
b. **Products and Resources:** Cattle, Sheep, Goats, Dairy Products, Hides and Skins, Gold, Silver, Copper, Zinc, Lead, Coal, Diamonds, Corn, Cotton, Wheat, Fruits, Rubber, Timber.
c. **Chief Cities: Salisbury (capital of Southern Rhodesia), Bulawayo, Livingstone (capital of Northern Rhodesia).**

D. **Swaziland: 3283, 3282 (map).** Area, 6,678 square miles; population, about 100,000. Products and resources: Tin, Gold, Cattle, Sheep, Goats, Pigs, Horses, Tobacco. Chief city: **Mbabane.**

E. **Southwest Africa Protectorate: 3283, 3282 (map).**
a. **Area, 322,400 square miles; Population, about 200,000.**
d. **Products and Resources:** Diamonds, Copper, Tin, Marble, Cattle, Sheep, Goats, Corn, Wheat.
c. **Capital and Chief City: Windhuk.**

F. **Union of South Africa: 3283.** This includes the provinces of **Cape of Good Hope, Natal 2398, Transvaal 3526, Orange Free State 2590.**
a. **Area, about 475,000 square miles; Population, about 6,950,000.**
b. **Chief Products and Resources:**
1. Agricultural Products: Wheat, Barley, Oats, Kaffir Corn, Potatoes, Tobacco, Cotton, Sugar.
2. Live Stock and Dairy Products: Butter, Cheese, Sheep, Goats, Cattle, Pigs, Horses, Mules, Asses, Ostriches, Wool, Mohair, Hides, Skins, Ostrich Feathers.
3. Minerals: Gold, Diamonds, Coal, Copper, Tin.
4. Manufactures: Leather, Tobacco, Dynamite, Soap, Rope, Wine, Furniture, Vehicles.
c. **Chief Cities: Cape Town (capital of Cape Province) 640; Kimberley, Port Elizabeth, Pietermaritzburg (capital of Natal), Pretoria (capital of Transvaal), Johannesburg 1895, Bloemfontein (capital of Orange Free State).**

VI. **MADAGASCAR: 2105** (French).

A. **Area, 228,000 square miles; Population, about 3,546,000.**

B. **Resources and Products:**
a. **Agriculture:** Rice, Sugar, Coffee, Manioc, Cotton, Vanilla, Tobacco, Cloves, Rubber.
b. **Mineral Resources:** Gold, Iron, Copper, Lead, Silver, Zinc, Nickel, Sulphur, Graphite, and Coal.
c. **Manufacturing:** Silk, Cotton Goods, Straw Hats, Metal and Food Products.

C. **Chief Cities:** Antananarivo (capital), Tamatave.

ASIA

ASIA, the giant of the continents, presents many extreme contrasts. It contains Mt. Everest, the highest peak in the world, and the Dead Sea basin, the lowest valley—more than 1000 feet below ocean level. It has the most extensive table-lands and the greatest area of lowland plains; the bleakest and most barren desert and the most fertile and densely populated farm lands; regions of the severest cold and of the greatest heat. Asia is the home of more than half the human race, and out of Asia have come so many great contributions to human progress that it is often called "the Mother of Civilization." Unlike the other continents, which have their mountains and highlands near the coasts and their lowlands in the interior, Asia consists of a huge mass of lofty ranges and plateaus in the center, surrounded by low plains or ancient worn-down uplands. The heaviest rainfall in Asia is found south and southeast of this great mountain mass, in the regions bordering the Indian Ocean and the Pacific. Western Asia is cut off from moist winds by the mountain masses of Europe, while northern Asia gets only the moisture which remains in the westerly winds after they have swept across the great European plain. The interior basins and table-lands are segregated on all sides from ocean winds, and it is there that the extreme desert conditions are found. The great variety of climate, the almost impassable desert and mountain barriers account in great measure for the sharp racial distinctions which exist upon the continent. White, Yellow, and Brown peoples dwell there today, and some scientists believe that the Black and Red races of the world likewise originated there, the former spreading to Africa and the latter to America.

I. POSITION AND AREA:
    - A. **The northern tip of Siberia lies nearly 600 miles inside the Arctic circle, while the southern tip of the Malay Peninsula almost touches the Equator. Connected by land in the west to Europe and Africa, the continent reaches in the extreme northeast to within 36 miles of America.**
    - B. **One-third of the land surface of the globe is included in Asia. With the exception of the Antarctic continent, Asia has the greatest average altitude, due to the enormous mass of highlands which stretch across its center.**

II. PHYSIOGRAPHY: **226, see also Maps next to page 232.**
    - A. **Mountains and Interior Plateaus:** The chief mountain ranges of Asia are connected in a long chain with many branches, stretching across the middle of the continent from Asia Minor to the Pacific Coast. The chief links in this chain are traced here from west to east.
        - a. **Plateau of Asia Minor or Anatolia, and Taurus Mountains: 234, 3557–8.**
        - b. **Elburz Mountains and Hindu Kush Marking Northern Boundary of the Great Iranian Plateau: 2733–4, 31, 226.**
        - c. **Great Pamir, the Meeting Place of the Hindu Kush, Karakoram (see Fact-Index), and Tien Shan Ranges: 226, 31, 3555.**
        - d. **Himalaya Mountains Forming a Vast Wall between the Central Highlands and the Plains of India: 1649, 1743.**
            - —Mount Everest, the Highest Mountain in the World: 1207.
        - e. **Plateau of Tibet between Himalayas and Kuenlun Mountains: 3495, 226, 740.**
        - f. **Plateau of Eastern or Chinese Turkestan between Tien Shan and Kuenlun Mountains: 3555, 226.**
        - g. **Gobi Desert and Plateau of Mongolia between Altai, Yablonoi, and Khingan Mountains: 740 (map), 228, 2285.**
    - B. **Detached Ranges:**
        - a. **Caucasus and Ural Mountains on Boundary of Europe: 663, 3606.**
        - b. **Volcanic Ranges on Pacific Side:** These extend through Kamchatka (1907), Sakhalin Island, the Kuril Islands, the islands of Japan (1863), the Korean Peninsula (1942), and Formosa (1332). These mountains are part of the same volcanic chain which runs through the islands of the East Indies (1070).
    - C. **Lowland Plains and Worn-Down Table-Lands:**
        - a. **Arabian Plateau and Plains of Mesopotamia: 165, 2200.**
        - b. **Plains of India and the Deccan: 1743–6.**
        - c. **Highlands and Plains of Indo-China and Siam: 1777, 3226.**
        - d. **Lowlands of Eastern China and Manchuria: 740, 2135.**
        - e. **Great Siberian Plains and Siberian Highlands: 3227–8.**
        - f. **Lowlands of Western or Russian Turkestan: 3556.**
    - D. **Chief Rivers and Lakes:**
        - a. **Rivers Flowing into the Arctic Ocean: Ob River, Yenisei, and Lena 230, 3228.**
        - b. **Into the Pacific: Amur 3228, 2135; Hwang 1706; Yangtze 3827.**
        - c. **Into the Bay of Bengal and Indian Ocean: Brahmaputra and Ganges 1745, 1393; Irrawaddy 540.**
        - d. **Into the Arabian Sea and Persian Gulf: Indus 1777; Tigris and Euphrates 3499, 1187, 2200.**
        - e. **Lakes and Inland Seas:**
            1. Black Sea—Asia Minor Forms Its Southern Shore: 434.
            2. Caspian Sea—Southern and Eastern Shores are Asiatic: 653.
            3. Sea of Aral with Its Two Tributaries, Syr-Daria and Amu: 172.
            4. Lake Balkash: (see Fact-Index); Lake Baikal: 305, 3228.

- E. Coastline:
  - a. **Arctic Ocean in the North: 189.**
  - b. **Arms of the Pacific Ocean in the East:** Bering Sea 383; Sea of Okhotsk 1907, 2619, 228; Sea of Japan 2619, 1864 (map); Yellow Sea, East China Sea, South China Sea 740 (map), 2619.
  - c. **Arms of the Indian Ocean in the South:** Bay of Bengal 1763, 1744 (map); Arabian Sea, Gulf of Oman, and Persian Gulf 1763, 2738, 166, 165 (map); Red Sea 2986.
  - d. **Mediterranean Shores of Asia Minor and Syria: 2193–4.**
  - e. **Chief Peninsulas:** Kamchatka 1907; Korean Peninsula 1943; Malay Peninsula 2129; Indian Peninsula 1743; Arabian Peninsula 165; Asia Minor 234.
- F. **Principal Islands along Coast of Asia: Sakhalin, Kuril Islands, Japanese Group 1863; Formosa or Taiwan 1332; Hainan (see Fact-Index); Andaman and Nicobar Islands 1756, 1763; Ceylon 684; Cyprus 947.** The islands of the East Indies are treated in a separate Outline.

III. CLIMATE:

- A. **Great Variety of Asiatic Climate: 226–7.**
- B. **High Mountain Ranges and Interior Plateaus Suffer from Extremes of Heat and Cold and from Lack of Well-Distributed Rain: 3495, 1649–50, 2733–4, 3556, 2285, 739–40.**
  —The great "Desert Belt" stretching over from Africa: 3104.
- C. **Siberia with Its Dry Steppes, Frozen Tundras, and Rain-Soaked Eastern Coast: 3228.**
- D. **Climate of Arabian Peninsula and Asia Minor: 3557-8, 165.**
- E. **Tropical Climate with Heavy Rains in the South and Southeast: 1747, 2129, 740.**
- F. **Tremendous Importance of Monsoon Winds to Southern Asia: 1746–7, 3751, 230.**

IV. MINERAL RESOURCES: Almost every known mineral is found in Asia, but there has been comparatively little development of these resources. Details concerning the mineral wealth are given in the division devoted to the separate countries of Asia.

V. VEGETATION AND ANIMAL LIFE:

Typical Plants of Asia:

- a. **Siberia: 226, 3228.** The region north of the great mountains falls into three zones: (1) the Arctic tundras where little grows except Moss and Berries; (2) the forest lands where there is enough rain to support extensive growths of Pine, Fir, Larch, Birch, Willow, and Poplar; and (3) the dry steppes where Grasses are the prevailing vegetation.
- b. **Central Highlands and Deserts: 3495, 3555, 2734, 165.** Except in rare sheltered valleys, desert oases, or the southern slopes of a few ranges, little vegetation of importance is found in the great mountain and desert belt which stretches across Asia.
- c. **Temperate Slopes of the Himalayas: 1650, 1748.** The southern sides of the great mountain barrier, exposed as they are to the effects of the monsoon winds, support a dense vegetation of trees and undergrowth. Typical forms are the Rhododendron, Magnolia, Deodar, Bamboo, and Cane.
- d. **Plains of India: 1748.** Typical forms here are the Babul, Mango, Banyan, Plantain, and Betel Palm.
- e. **Tropical South: 1748, 541, 2129, 3226–7.** Typical forms are Teak, Sandalwood, Satinwood, Ironwood, Ebony, Rosewood, Bamboo, Orchids, Catechu Plant, and innumerable Spice Plants (3317).
- f. **Eastern Coast:** The coastal plains of China are so densely inhabited and so closely cultivated that there is virtually no wild vegetation.

- B. Typical Animals of Asia:
  - a. **Northern Zone:** Reindeer 2993; Polar Bear and Brown Bear 355; Seal 3167; Wolf 3774; Fox 1943; Badger 304; Ermine 1174; Mink 1390; Sable-Marten 2155; Otter 2605; Gray Squirrel 3334; Hare 1585.
  - b. **Central and Southern Zone:** Monkeys 2288–92; Elephant 1126; Rhinoceros 3006; Tiger 3498; Lion 2024, 1748; Leopard 1988; Himalayan Bear and Sun Bear 355; Hyena 1711; Jackal 1855; Wild Dog or Dhole 1748; Wild Ass 235; Camel 590; Yak 3827; Buffalo 527; Ibex and other Wild Goats 1719, 1476; many species of Wild Sheep 3198–3200, Antelopes 146–7, and Deer 979–81; Wild Boar 440; Mongoose 2286; Giant Squirrel 3334 (picture); Bats 345–6; Hornbill 1681; Pheasant 2759; Peacock 2699; Weaver-Bird 3710 (picture); Crocodile 923; Cobra 816; Python 2942.

VI. MANKIND IN ASIA:

- A. Native Peoples:
  - a. **White:** Arabs and Bedouins 165, 232; Jews 1889; Syrians 3425; Armenians 213, 664; Kurds 1945, 213, 2735; Persians 2735; Hindus 1651, 1748; Afghans 31.
  - b. **Yellow:** Southern Chinese 742; Indo-Chinese 1777, 2130, 3227; Tibetans 1748, 3496; Manchus 746, 2134; Kalmuks 2286; Cossacks 896; Tatars 3440; Kirghiz 230; True Mongols 2285; Turkomans 3555; Turks 3557–8; Japanese 1332, 1862; Koreans 1942.
  - c. **Brown:** Gonds, Bhils, Tamils 1748; Veddahs 685; Malays 2130.
  - d. **Black:** Semangs and Sakais 2130; Andaman Islanders 1756.
- B. Europeans in Asia—Exploration and Conquest:
  - a. **Alexander the Great, First European Leader to Invade Asia: 1752, 87.**
  - b. **Marco Polo, First European Traveler to Cross the Whole of Asia: 2874.**
  - c. **Vasco da Gama Finds Sea Route around Africa to Asia: 233, 2888, 640.**
  - d. **The Work of Francis Xavier, Exploring Missionary: 3823.**

- e. Portuguese, Dutch, French, and British in India: **1752–3.**
- f. Achievements of Robert Clive and Warren Hastings: **795, 1596.**
- g. Russians Spread over Northern Asia: **233, 3227–8.**
- h. China Forced to Open Doors to Europeans: **746.**
- i. Commodore Perry in Japan: **233, 1862.**
- j. British in Tibet under Col. F. E. Younghusband: **3496.**

Asiatic Russia and Allied Territory

ASIATIC Russia consists chiefly of Siberia and Western Turkestan. Western and northern Siberia remained after the rise of the Bolshevists a part of the Russian Soviet Republic. The territory south of the Lena River, between Lake Baikal and Vladivostok, asserted its independence under the name of the Far Eastern Democratic Republic, but in the year 1922 it became an integral part of the Soviet Republic. In Russian Turkestan several independent soviets arose, which joined, however, the Soviet Federation. The two states of Bokhara and Khiva in southern Turkestan also organized as soviets and joined the federation. On the other side of the Caspian Sea in the Caucasus, the states of Georgia, Azerbaijan, and Armenia pursued the same course. All of these regions are treated in this section.

- I. PHYSIOGRAPHY:
  - A. Siberian Plains—Divided into Arctic Tundras, Central Timber Lands, and Southern Steppes: **3227–8, 190, 226, 230.**
  - B. Plains and Deserts of Western Turkestan: **3555–6.**
  - C. Mountains and Highlands:
    - a. Ural Mountains on the Boundary between European and Asiatic Russia: **3606.**
    - b. Eastern Highlands **3228**; Stanovoi Mountains (see Fact-Index).
    - c. Tien Shan, Pamir, Hindu Kush, and Elburz on Southern Border: **226, 3555, 2734, 31.**
  - D. Rivers: Ob, Yenisei, Lena, and Amur **230, 3228, 2135.**
  - E. Lakes and Inland Seas: Caspian Sea **653**; Sea of Aral **172**; Lake Baikal **305, 3228**; Lake Balkash (see Fact-Index).
- II. RESOURCES AND PRODUCTS: **3228, 3556.**
  - A. Agriculture: Wheat, Rye, Oats, Barley, Vegetables.
  - B. Stock Raising and Dairying: Cattle, Sheep, Camels, Eggs, Butter.
  - C. Timber and Timber Products.
  - D. Minerals and Mining: Coal, Iron, Petroleum, Copper, Lead, Silver, Gold, Platinum, Graphite, Tin, Zinc, Salt, Mica, Precious Stones.
  - E. Fur Industry: Seal, Fox, Ermine, Mink, Sable-Marten, Otter, Gray Squirrel.
  - F. Manufacturing: Rugs (**3079**), Textiles, Leather.
- III. AREA AND POPULATION:
  - A. Siberia (under Russian Soviet Republic): Area, about **4,200,000** square miles; Population, about **9,200,000.**
  - B. Russian Turkestan (excluding Bokhara and Khiva): Area, about **1,200,000** square miles; Population, about **7,000,000.**
- IV. CHIEF CITIES:
  - A. Siberia: Irkutsk, Omsk, and Tomsk **3229.**
  - B. Turkestan: Tashkend, Khokand, Samarkand **3556.**

STATES ALLIED TO RUSSIA

- I. FAR EASTERN REPUBLIC: **3229.**
  - A. Area, about **650,000** square miles; Population, about **1,800,000.**
  - B. Resources and Products: Wheat, Gold, Silver, Iron, and Fisheries.
  - C. Chief Cities: Vladivostok **3652**; Chita (see Fact-Index).
- II. BOKHARA: **3555–6.**
  - A. Area, about **83,000** square miles; Population, about **1,250,000.**
  - B. Resources and Products: Wheat, Fruit, Silk, Rugs, Tobacco, Cotton, Live Stock (including Camels), Gold, Alum, Sulphur.
  - C. Chief Cities: Bokhara and Karshi.
- III. KHIVA: **3556.**
  - A. Area, about **24,000** square miles; Population, about **646,000.**
  - B. Resources and Products: Wheat, Cotton, Silk, Live Stock.
  - C. Chief City: Khiva.
- IV. ARMENIA: **211.**
  - A. Area, **16,000** square miles; Population, about **1,200,000.**
  - B. Resources and Products: Wheat, Fruits, Tobacco, Cotton, Iron, Copper, Mercury, Lead, and Gold.
  - C. Chief City: Erivan.
- V. GEORGIA: **1434.**
  - A. Area, about **25,000** square miles; Population, about **2,400,000.**
  - B. Resources and Products: Grapes, Fruits, Silk, Bees, Live Stock, Manganese, Copper, Coal, Lead, Iron.
  - C. Chief Cities: Tiflis (capital), Kutais, Sukhum.

VI. AZERBAIJAN: 664, 3084.
  - **A. Area, 40,000 square miles; Population, about 4,600,000.**
  - **B. Resources and Products: Petroleum (2749, 2752), Wheat, Cotton, Silk, and Live Stock.**
  - **C. Chief City: Baku.**

Japan

IT is important to observe how Japan, whose geographical situation so strikingly resembles that of Great Britain, has come to play a part in Asiatic affairs closely akin to the British world policy. Less than a century ago Japan was an isolated island-state, having apparently no interest in the outside world. Its people pursued agriculture and primitive crafts, unmindful of the march of western civilization. Then, as if by magic, all this was transformed. Within the span of one man's lifetime, Japan became a power in world politics and in world commerce. The home islands were no longer able to produce enough food for the expanding population, so the Japanese were forced to build up manufacturing industries and to develop a foreign commerce to dispose of their manufactured products. The Japanese emigrated in large numbers to foreign lands, particularly to China, Australia, the islands of the Pacific, and the western coast of North America. The Japanese government feeling the need of additional territory for commercial expansion seized every opportunity to gain a foothold on the mainland of Asia. To support its claims and gain an equal voice in international politics, Japan built a powerful navy and organized a large and efficient standing army. A victorious war with Russia, an alliance with Great Britain, and a strategic position during the World War further advanced Japanese prestige and increased Japanese possessions. Meanwhile the Japanese people had gained a greater measure of political liberty and developed individual enterprise. Today, Japan's desire to be the dominant factor in the affairs of China and to develop the vast resources of that country along lines favorable to Japanese interests is one of the delicate problems in international relations.

I. PHYSIOGRAPHY:
  - **A. Volcanic Mountains of Japan: 1863.**
    - **a. Most prominent peak Mount Fujiyama: 1866 (picture).**
    - **b. Earthquakes: 1064.**
  - **B. Important Lowlands of Japan: 1864.**
  - **C. Broken Coastlines Provide Many Good Harbors: 1864.**

II. NATURAL RESOURCES AND PRODUCTS: 1864–8.
  - **A. Agriculture: Rice (3013), Tea (3445), Wheat, Barley, Rye, Tobacco (3510), Vegetables, Bamboo.**
  - **B. Mining and Minerals: Copper, Iron, Petroleum, Silver, Kaolin Clay, Coal (supply insufficient for needs of islands).**
  - **C. Forests and Forest Products: 1866.**
  - **D. Fresh and Salt Water Fisheries: Sturgeon, Mackerel, Salmon, Flounder, Halibut, Shad, Herring, Oysters.**
  - **E. Manufacturing: Cotton Goods, Silk (3234–6 pictures), Woolens, Iron and Steel Products, Matches, Toys, Pottery, Glassware, Lacquer-ware (1954), Paper, Camphor (594), Art Objects (1873–6), Ink, Machinery and Chemicals.**

III. CHIEF CITIES: Tokyo (capital) 3510; Osaka 2602; Kobe 1864; Kyoto 1945; Nagoya 2387; Yokohama 3830.

IV. POSSESSIONS:
  - **A. Korea: 1942.** Area, 84,738 square miles; population, about 17,500,000. Chief resources and products: Rice, Wheat, Beans, Tobacco, Cotton, Live Stock, Gold, Copper, Iron, Coal. Chief city, Seoul 1943.
  - **B. Formosa: 1332.** Area, about 14,000 square miles; population, about 3,700,000. Resources and products: Rice, Tea, Sugar, Sweet Potatoes, Camphor, Fish, Live Stock, Coal. Chief city, Taihoku.
  - **C. Japanese Sakhalin: 1863.** Area, about 13,000 square miles; population, about 100,000. Resources and products: Timber, Fish, Coal, and Gold.
  - **D. Other Possessions:** Kuril and Nansei Islands 1863; Marianas or Ladrones, Pelew, Caroline, and Marshall Islands 2620, 2624; Kwantung (leased territory in Manchuria) 2135; Kiaochow (part of Shantung district, 3195) was returned to China in 1922.

China

CHINA has an area larger than that of the United States, Mexico, and Central America put together; and its population is almost as great as the combined population of North America, South America, and Africa. Yet the power latent in this vast land and its countless people is for the most part lost through lack of organization. The Chinese are industrious, thrifty, resourceful, and physically vigorous; as settlers in foreign lands they make their own way with skill and independence, accumulating modest wealth in the face of all competition. But this very independence and attitude of "every-man-for-himself" stands in the way of the effective political organization of the Chinese at home. Only the rivalry of foreign powers, which have prevented one another from taking advantage of China's weakness, has kept this great country more or less intact and politically independent. Today, there are signs of an aroused national feeling in China. Out of revolutions and disorder the great mass of the people seem to be awakening to their opportunities and to the need for united action. Railroads to tap the vast mineral wealth of the interior are the greatest present need.

I. DIVISIONS OF GREATER CHINA: The province of **China proper** occupies the southeastern corner of the country. The other provinces or districts are **Manchuria (2134)** in the northeast, **Mongolia (2285)** in the north, **Sinkiang including Chinese Turkestan (3555)** in the west, and **Tibet (3495)** in the southwest.

II. PHYSIOGRAPHY:

- **A. Plains of China and Manchuria: 740, 2135.**
  - **—Rich "Loess"** Soil: **3273, 3750.**
- **B. Mountains and Plateaus:**
  - **a. Khingan Mountains of Manchuria and Mongolia: 2135, 2285, 740** (map).
  - **b. Altai Mountains and the Plateau of Mongolia, Including the Gobi Desert: 2285, 740** (map).
  - **c. Tienshan and Kuenlun Mountains Inclosing the Plateau of Chinese Turkestan: 3555, 226.**
  - **d. Plateau of Tibet Bordered on the South by the Himalayas: 3495, 1649.**
- **C. Rivers: Yangtze 3827; Hwang 1706; Amur 2135; Si-kiang (see Fact-Index).**
- **D. Island of Hainan: 740 (map), see also Fact-Index.**

III. RESOURCES AND PRODUCTS: 744, 2135, 2285, 3556, 3495.

- **A. Agriculture: Rice (3013), Wheat, Barley, Corn, Millet, Sugar, Indigo, Tobacco, Soy Beans (3297), Tea (3445), Ginseng (1460), Bamboo (323), Cotton.**
- **B. Live Stock: Pigs, Cattle, Buffaloes, Sheep.**
- **C. Fisheries: 749, 1286, 751** (picture).
- **D. Minerals and Mining: Coal, Iron, Petroleum, Copper, Tin, Antimony, Gold, Silver, Lead, Bismuth.**
- **E. Silk Industry: 3234; Pearl Fishing: 2703.**
- **F. Manufacturing: Textiles, Pottery, and Porcelain (2882, 2903); Rugs (3079); Lacquer-ware (1954), Paper, Pig Bristles.**
- **G. Transportation:** There are few railways in China, but the network of rivers and canals, including the **Grand Canal (625)**, is very important to commerce **230, 749, 638, 3827, 1706.**

IV. POPULATION, AREA, AND CHIEF CITIES:

- **A. China Proper: 739.**
  - **a. Area, about 1,533,000 square miles; Population, about 336,000,000.**
  - **b. Chief Cities: Peking (capital) 2707; Shanghai 3195; Canton 638; Tientsin 3498; Nanking 2389; Foochow 1319; Hankow 1574; Hangchow 1574.**
- **B. Manchuria: 2134.** Area, about 364,000 square miles; population, about 12,000,000. Chief cities: **Mukden** 747 (picture); **Harbin.**
- **C. Mongolia: 2285.** Area, about 1,370,000 square miles; population, about 2,500,000. Chief city, **Urga.**
- **D. Sinkiang including Chinese Turkestan: 3555.** Area, about 550,000 square miles; population, about 1,200,000. Chief cities: **Urumchi** (capital), **Yarkand, Khotan, Kashgar.**
- **E. Tibet: 3495.** Area, about 463,000 square miles; population, about 2,000,000. Chief city, **Lhasa.**

V. POSSESSIONS OF FOREIGN COUNTRIES ON CHINESE COAST:

- **A. Hongkong: 1678,** (British). Area, 391 square miles; population about 570,000. Chief city, Victoria (commonly called Hongkong).
- **B. Weihaiwei: see Fact-Index** (British leased territory). Area, about 285 square miles; population, 150,000.
- **C. Kwangchow: see Fact-Index** (French). Area, about 190 square miles; population, about 168,000.
- **D. Macao: see Fact-Index** (Portuguese). Population, 75,000.
- **E. Kwantung** (Japanese). Area, about 540 square miles; population, about 600,000.

Indo-China and Malay Peninsula

The peninsula of Indo-China is divided into French Indo-China (1777) in the east, Siam (3226) in the center, and a narrow strip of Burma down the west coast. The kingdom of Siam extends down into the Malay Peninsula (2129), where it meets the Malay States, which are under British control. The people of these countries show the mixed traits of the Hindus, Chinese, and Malays. The chief physiographic features consist of northern highlands, which spread like a fork down the east and west coasts, extending to the tip of the Malay Peninsula, and inclosing central lowlands and narrow coastal plains on the Gulf of Siam.

I. PRODUCTS AND RESOURCES: 1777, 3226, 2129.

- **A. Agriculture; Rice, Rubber, Corn, Tobacco, Tropical Fruits, Sago, Sugar Cane, Tapioca, Spices, Tea, Coffee.**
- **B. Forests: Ebony, Rosewood, Teakwood, Ironwood, Rattan.**
- **C. Minerals and Mining: Tin (3504), Coal, Tungsten, Gold, Iron, Copper, Zinc, Precious Stones (1409).**

II. POLITICAL DIVISIONS:

- **A. French Indo-China: 1777.** Consisting of five districts (Cochin-China, Anam, Cambodia, Tonkin, and Laos). Total area, about 300,000 square miles; population, about 17,000,000. Chief cities: **Hanoi, Cholon, Pnompenh, Binh-Dinh,** and **Saigon.**
- **B. Siam: 3226** (Independent). Area, about 200,000 square miles; population, about 9,000,000. Capital and chief city, **Bangkok (326).**

- C. **Malay States: 2129** (British).
    - a. **Federated States:** Area, about 27,500 square miles; population, about 1,037,000.
    - b. **Non-Federated States:** Area, about 23,500 square miles; population, about 1,120,000.
- D. **Straits Settlements: 2130-1** (British). Area, about 1350 square miles; population, about 715,000. Chief city, **Singapore (3243).**

India

INDIA is the home of a population almost as great as China's and of a civilization more ancient than that of Europe. This civilization is rooted in great measure in the religion and religious customs of the Hindus, complicated by the later arrival of a wave of Mohammedanism which continues to be a powerful influence in the land. The difficulties which the British encounter in ruling this empire are caused by the combined influence of religious opposition and the extreme poverty of the great mass of the people. While much of the soil is exceedingly fertile, there are also large arid and unfruitful areas, particularly in the west. One of the most important tasks in India is to increase the territory available for agriculture by stimulating irrigation enterprises, and to establish manufacturing industries which will utilize the surplus "man-power." A large proportion of the natives, however, strongly resent the effort to make them work in factories and express a desire to return to the old household arts of their forefathers. Frequent demands for home rule have been made in recent years.

- I. PHYSIOGRAPHY:
    - A. **Mountains and Plateaus:**
        - a. **Himalaya Mountains and Hindu Kush on Northern Border: 1649, 226.**
        - b. **Baluchistan Highlands in the Extreme West: 1743, 226.**
        - c. **Highlands of Burma in the Extreme East: 541.**
        - d. **Deccan Table-land in the South, Surrounded by the Vindhya Mountains and the Eastern and Western Ghats: 1744, 1745-6.**
    - B. **Plains of Hindustan between Northern Mountains and Deccan: 1745.**
    - C. **Rivers: Indus 1777; Ganges 1393; Brahmaputra 382; Irrawaddy 540.**
- II. RESOURCES AND PRODUCTS: **1751-2, 541, 1707, 382, 653.**
    - A. **Agriculture: Millet, Rice, Wheat, Cotton, Flax, Jute (1906), Sugar Cane, Tea (3445), Indigo (1777), Mustard, Tobacco.**
    - B. **Live Stock: Cattle (1749 picture), Buffaloes (527 picture), Sheep, Goats.**
    - C. **Forests and Timber: 1748. Teak (3451) and Sandalwood (3123).**
    - D. **Minerals and Mining: Coal, Gold, Petroleum, Manganese, Salt, Lead, Tungsten, Mica (2219), Precious Stones (1409).**
    - E. **Manufacturing: Cotton, Silk, Jute, Sugar, Shawls, Rugs, Lacquer-ware, Leather, Opium, Hemp.**
- III. CHIEF CITIES: **Calcutta 572; Bombay 451; Madras 2108; Hyderabad 1707; Rangoon 541; Delhi 989; Lucknow 2075; Benares 380.**
- IV. NEIGHBORING STATES AND POSSESSIONS:
    - A. **Ceylon: 684** (British Colony). Area, about 25,000 square miles; population, about 4,700,000. Resources and products: Tea, Coffee, Rice, Cacao, Rubber, Spices, Graphite, Pearls and other Precious Stones. Chief city, **Colombo.**
    - B. **Nepal: 1744** (under British supervision). Area, about 54,000 square miles; population, about 5,600,000. Chief city, **Khatmandu.**
    - C. **Bhutan: 1744** (under British supervision). Area, about 20,000 square miles; population, about 250,000. Chief city, **Punakha.**
    - D. **French India: 1756.** Consisting of five small colonies (Pondicherry, Karikal, Yanaon, Mahe, and Chandernagore). Total area, 203 square miles; population, about 265,000.
    - E. **Portuguese India: 1756.** Consisting of three establishments (Gôa, Damao, and Diu). Total area, 1638 square miles; population, about 550,000.

Persia and Afghanistan

THESE two countries occupy the rugged mountains and arid table-lands which divide what we call the Near East from Central Asia and the Far East. They are among the least progressive of the Asiatic states, having virtually no railroads or industrial organization. In the more remote mountain regions dwell many peoples and tribes which are virtually independent. Afghanistan has no seacoast, while Persia's coastlines contain no harbors of importance. The link which binds these countries to the Near East and to northern India is the prevailing influence of the Mohammedan religion.

- I. PERSIA: **2733.**
    - A. **Physiography:** The **Elburz Mountains** in the north, and the vast stretches of the **Iranian Plateau** in the center and south are the chief physical features. The **Caspian Sea** (653) forms part of the northern boundary, while, in the south, Persia extends along the **Persian Gulf** (2738) and the **Gulf of Oman.**
    - B. **Resources and Products:**
        - a. **Agriculture and Live Stock:** Wheat, Barley, Rice, Fruits, Sheep, Camels, Cattle, Goats.

   - b. **Minerals:** Iron, Coal, Copper, Lead, Manganese, Borax, Nickel, Petroleum.
   - c. **Manufacturing:** Silk, Woolens, Carpets, Opium, Gums, Leather.
- C. **Area, about 628,000 square miles; Population, about 9,000,000.**
- D. **Chief Cities: Teheran (capital) 2734, Tabriz, Ispahan.**

II. AFGHANISTAN: 31.

- A. **Physiography:** The northeastern half of Afghanistan is covered by the ridges and spurs of the **Hindu Kush** mountains; the southwestern half is a continuation of the **Iranian Plateau,** extending over from Persia.
- B. **Resources and Products:**
   - a. **Agriculture and Live Stock:** Wheat, Barley, Rice, Millet, Corn, Fruits, Tobacco, Sheep, Goats, Camels, Cattle.
   - b. **Minerals:** Copper, Lead, Iron, Gold, Precious Stones.
   - c. **Manufacturing:** Silks, Felt, Carpets, Leather, Food Products.
- C. **Area, about 245,000 square miles; Population, about 10,000,000.**
- D. **Capital and Chief City: Kabul.**

Divisions of Southwestern Asia

POLITICAL conditions in the Near East are so unsettled and political boundaries are subject to such constant readjustments that it is better for geographical purposes to divide this part of Asia into a few large natural regions rather than to attempt to study separately each of the many states, principalities, emirates, mandates, or other political units, whose conflicting claims form one of the chief sources of international discord in Europe and Asia. Before the World War, this entire region formed part of the Turkish Empire, but during and after the war it split into many fragments. Here we shall consider four major divisions: (1) Asiatic Turkey proper or Anatolia, occupying chiefly the peninsula of Asia Minor; (2) Syria and Palestine, lying along the Mediterranean between Asia Minor and the Isthmus of Suez; (3) Mesopotamia, occupying the Tigris-Euphrates basin from northern Syria to the Persian Gulf; and (4) Arabia, comprising the entire Arabian Peninsula south of Mesopotamia and Syria. The republics of Armenia, Azerbaijan, and Georgia are treated under Asiatic Russia.

I. ASIATIC TURKEY OR ANATOLIA: 3557.

- A. **Physiography:** The plateau of **Asia Minor** (234) is surrounded on all sides by mountains extending to the shores of the Black Sea and the Mediterranean, the most important being the **Taurus Mountains** in the south and southeast.
- B. **Resources and Products: 3557, 234.**
   - a. **Agriculture and Live Stock:** Wheat, Oats, Barley, Tobacco, Cotton, Grapes, Olives, Figs, Sheep, Cattle, Goats, Asses, Horses.
   - b. **Minerals:** Copper, Coal, Zinc, Lead, Antimony, Manganese, Borax, Salt, Gold, Silver.
   - c. **Forests and Forest Products:** Timber, Gums, Wild Fruit.
   - d. **Manufacturing:** Cotton Goods, Woolens, Silk, Rugs, Leather, Opium, Olive Oil.
- C. **Area, about 175,000 square miles; Population, about 8,000,000.**
- D. **Chief Cities: Smyrna 3255, Brusa, Trebizond.**

II. SYRIA AND PALESTINE: 3425, 2643.

- A. **Physiography:** Low mountains rise from the Mediterranean coast, except in the extreme south where there is a strip of coastal plain. Beyond these mountains lie narrow river valleys parallel to the coast, including the valley of the **Jordan** and the basin of the **Dead Sea,** which sinks far below sea level. Beyond these again lie the arid stretches which mark the beginning of the great **Arabian Desert.**
- B. **Resources and Products: 3426, 2645.**
   - a. **Agriculture and Live Stock:** Wheat, Barley, Millet, Fruits, Tobacco, Cotton, Hemp, Olives, Sheep, Goats, Cattle, Camels, Asses, Horses.
   - b. **Minerals:** No rich mineral resources have been discovered, but there are traces of Iron, Lead, Copper, Lignite, and Petroleum.
   - c. **Manufacturing:** Silk, Olive Oil, Wine.
- C. **Area, Population, and Chief Cities:**
   - a. **Syria** (French Mandate). Area, about 114,000 square miles; population, about 3,000,000. Chief cities: **Damascus 954, Aleppo, Beirut, Antioch 150.**
   - b. **Palestine** (partly British Mandate). Area, about 15,000 square miles (British mandate, 9,000 square miles); population, about 650,000. Chief cities: **Jerusalem 1885, Jaffa.**

III. MESOPOTAMIA OR IRAK: 2200 (Arab state under British protection).

- A. **Physiography:** Mesopotamia consists of a lowland plain which forms the valleys of the **Tigris** (3499) and the **Euphrates** (1187). It is for the most part treeless, and, except along the rivers, is an unproductive desert. However, with irrigation, the soil becomes exceedingly fertile.
- B. **Resources and Products:** Wheat, Barley, Cotton, Dates, Petroleum.
- C. **Area, about 143,000 square miles; Population, about 2,800,000.**
- D. **Chief Cities: Bagdad 304, Basra.**

IV. ARABIA: 165. The territory of Arabia is divided into a group of independent and semi-independent native states, the most important of which are Hejaz, Asir, and Yemen along the Red Sea coast; Jebel Shammar and Nedjed-Hasa in central Arabia, the latter extending to the Persian Gulf; Koweit at the head of the Persian Gulf;

and Oman, extending around the eastern tip of the Arabian peninsula from the Persian Gulf to the Indian Ocean. The British protectorate of Aden (24) occupies the other tip of the peninsula at the mouth of the Red Sea.

- **A. Physiography:** Arabia is mostly a great desert table-land bordered by narrow coastal plains and, in the south, by low mountain ranges.
- **B. Resources and Products:** Dates, Live Stock, Hides, Wool, Coffee (from Mocha in the state of Yemen, 822).
- **C. Total Area, about 1,250,000 square miles; Population, about 7,000,000.**
- **D. Chief Cities: Mecca 2187, Medina, Mocha, Muskat, Aden 24.**

East Indies

THE large group of islands lying between the southeast coast of Asia and the continent of Australia are known as the East Indies or the Malay Archipelago. The island of Sumatra marks the western extremity of the group, the Philippines the northern extremity, and the island of New Guinea the eastern extremity, the islands outside of these limits being considered as belonging to Asia, to Australia, or to some of the Pacific Ocean archipelagoes. The size of the larger East Indian islands is not ordinarily appreciated, because they are usually represented on small-scale maps; a clearer idea of their area may be obtained from the fact that two of them—New Guinea and Borneo—are each considerably larger than the state of Texas.

I. PHYSIOGRAPHY AND CLIMATE:

- **A. Islands of Volcanic Origin, Containing Many Active and Extinct Cones: 2764, 3391, 671, 1072.**
- **B. Typical Formation:** Most of the islands have mountainous interiors, cut up by river valleys and surrounded by coastal plains.
- **C. Hot Equatorial Climate:**
  - **a. Tempering Effect of Mountains and Sea Winds: 1879, 2765, 3391, 671.**
  - **b. Heavy Rainfall: 2974, 3391, 2765.**

II. PEOPLE OF THE EAST INDIES:

- **A. Chief Native Races:**
  - **a. Malayan Types:** Javanese 1879, Sumatrese 3391; Dyaks 467; Igorots 2765; Moros 2766.
  - **b. Papuans or Melanesians: 1072, 2451.**
  - **c. Negrito Types: 2765.**
- **B. Discovery and Colonization by Whites: 1072.**

III. RESOURCES AND PRODUCTS: 2768-9, 1879, 3391, 468, 671, 2453.

- **A. Agriculture and Forest Products: Rice, Corn, Tea, Soy Beans, Spices (3317), Pepper (2723), Coffee (822), Cane Sugar, Cacao, Coconuts 818 (picture), Bananas, Tobacco, Manila Hemp (1630), Indigo (1777), Quinine (2950), Rubber (3072, 3074), Gutta-Percha (1554), Ebony, Teak, Sandalwood.**
- **B. Minerals and Mining: Copper, Iron, Gold, Tin, Petroleum, Coal, Mercury, Precious Stones.**

IV. PRINCIPAL ISLANDS:

- **A. Philippine Islands: 2764** (United States). Group comprises 7,083 islands, the two largest being **Luzon** and **Mindanao.** Total area, 115,026 square miles; population, about 10,350,000. Capital and chief city, **Manila 2136.**
- **B. Sumatra: 3391** (Dutch). Area, about 167,000 square miles; population, about 4,000,000. Chief Cities: **Padang, Palembang.**
- **C. Java: 1877** (Dutch). Area, 50,557 square miles; population, 35,000,000. Chief city, **Batavia 1878.**
- **D. Madura: see Fact-Index** (Dutch). Area, 1,725 square miles, population, 2,000,000.
- **E. Borneo: 467** (Dutch and British). Area, 290,000 square miles; population, 1,850,000. The island is divided into the following four districts:
  - **a. British North Borneo: 468.** Area, 31,106 square miles; population, 208,000. Chief city, **Sandakan.**
  - **b. Brunei: 468** (British). Area, 4,000 square miles; population, 32,000. Chief city, **Brunei.**
  - **c. Sarawak: 468** (British). Area, 42,000 square miles; population, 600,000. Chief cities: **Kuching** (capital), **Sibu.**
  - **d. Dutch Borneo:** Area, 212,800 square miles; population, 1,010,000. Chief cities: **Pontianak, Banjermasin.**
- **F. Flores: see Fact-Index** (Dutch). Area, 5,850 square miles; population, 250,000.
- **G. Timor: see Fact-Index** (Dutch and Portuguese). Area: Dutch, 5,200 square miles; Portuguese, 7,300 square miles. Population, about 600,000 equally divided between Portuguese and Dutch territory. Chief cities: **Delli** (Port.), **Kupang** (Dutch).
- **H. Celebes: 671** (Dutch). Area, 72,000 square miles; population, 2,000,000. Chief city and capital, **Macassar.**
- **I. Molucca Islands: see Fact-Index** (Dutch). Area, 144,120 square miles; population, 560,000. Chief city, **Amboyna.**
- **J. New Guinea: 2451** (Dutch and British). Area, 300,000 square miles; population, about 1,000,000.
  - **a. Dutch New Guinea: 2453.** Area, 121,339 square miles; population, 555,000. Chief city, **Sorong.**
  - **b. British New Guinea: 2453** (Former German possession). Area, 70,000 square miles; population, about 300,000. Chief city, **Madang.**
  - **c. Papua: 2453** (British). Area, 90,540 square miles; population, about 250,000. Chief city, **Port Moresby.**

AUSTRALIA

New Zealand and Pacific Islands

AUSTRALIA is the smallest of the continents. It was the last of the inhabitable portions of the globe to be explored and settled by white men. Geologists tell us that this great island is probably the oldest land surface of the Earth, having emerged from the sea in exceedingly remote ages. Consequently its mountain masses are worn down and low. In size it is about equal to the United States, and if it were turned over in the north-to-south sense, it would almost fit the shape of the United States, the Cape York Peninsula taking the place of Florida. Occupying the same latitude as South Africa, it resembles South Africa in many important geographical features, chief of which is the division of the country into an arid western zone and a rainy eastern zone. The Australian natives may well be likened to the Bushmen and Hottentots of South Africa; both countries have had important gold rushes; and both countries are today part of the British Empire. Southeast of Australia lies New Zealand, the largest group of islands in the Pacific, outside of the East Indies. The remainder of the Pacific Islands lie scattered over the vast watery stretches which separate Asia and Australia from the two Americas, most of them lying within the tropics.

I. AUSTRALIA: 261.

- **A. Physiography: 261–2.**
  - **a. Western Australian Plateau Including the Desert Region: 262.**
  - **b. Great Central Plains: 262, 2449–50.**
  - **c. East Australian Highlands, Including the Great Dividing Range: 262, 2471.**
  - **d. Murray and Darling Rivers Form Only Important River System of Australia: 262–4.**
  - **e. Coastline Smooth with Few Good Harbors: 262.**
    - **— Great Barrier Reef: 262, 886.**
  - **f. Tasmania, the Only Important Island Belonging to Australia: 3438.**
- **B. Climate: 262.**
  - **a. Typical Tropical Climate in the North: 262, 2949.**
  - **b. Seasonal Change in the South; High Temperature of the Interior 2471.**
  - **c. Rainfall: Uncertain and Insufficient in the Interior and on the West Coast 262; Heavy on Eastern Coast 262, 2949.**
  - **d. Temperate Climate of Tasmania: 3438.**
- **C. Vegetation and Animal Life: 265–6.**
  - **a. Typical Vegetation:** Eucalyptus 1186; Acacia 4; Tree Ferns, Gigantic Tulips, and Lilies 265; Tall Tropical Grasses 262.
  - **b. Typical Animals:** Rabbit 1585; Dingo (Wild Dog) 266; Kangaroo, Wombat, Bandicoot 1908; Gray Opossum 266 (picture); Tasmanian Devil 3438 (picture); Tasmanian Wolf 3439 (picture); Duckbill 1046 (picture); Spiny Ant-Eater 1047, 266 (picture); Frilled Lizard 2036, 2035 (picture); Laughing Jackass 266; Emu 1145 (picture); Cassowary 654; Black Swan 3400; Lyre Bird 2092; Brush Turkey and Mallee-Bird 1090; Bower-Birds 405.
- **D. Mankind in Australia:**
  - **a. Discovery, Exploration, and Settlement; 266–7, 3438, 872.**
  - **b. Natives: Blackfellows 261, 266, 2119 (picture); Tasmanians 3438.**
  - **c. White Population:** More than 95 per cent of the entire population is of British origin.
- **E. Natural Resources and Industries: 264–5, 2949–50, 2471, 3438–9, 3638.**
  - **a. Sheep and Cattle Raising the Most Important Industry.**
  - **b. Agriculture: Wheat (3732), Oats, Barley, Corn, Hay, Potatoes, Sugar Cane, Grapes, Fruit.**
  - **c. Minerals and Mining: Coal, Gold, Silver, Lead, Copper, Tin, Zinc, Tungsten.**
  - **d. Manufacturing: Wool, Leather, Chemicals, Metal Products, Lumber.**
- **F. Divisions of Australia:**
  - **a. New South Wales: 2471.** Area, 309,432 square miles; population, 2,300,000. Capital and chief city, **Sydney 3424.**
  - **b. Victoria: 3638.** Area, 88,000 square miles; population, 1,675,000. Capital and chief city, **Melbourne 2194.**
  - **c. Queensland: 2949.** Area, 670,500 square miles; population, 850,000. Capital and chief city, **Brisbane.**
  - **d. South Australia: see Fact-Index.** Area, 380,070 square miles; population 470,000. Capital and chief city, **Adelaide 268.**
  - **e. Western Australia: see Fact-Index.** Area, 975,920 square miles; population 332,000. Capital and chief city, **Perth.**
  - **f. Tasmania: 3438.** Area, 26,215 square miles; population 220,000. Capital and chief city, **Hobart.**
  - **g. Territories:**
    - **1. Federal Capital Territory, Canberra: 628.**
    - **2. Northern Territory: see Fact-Index.** Area, 523,620 square miles; population 24,706. Chief city, **Port Darwin.**

- h. **British Possessions Administered by the Australian Commonwealth:** Territory of Papua (2453); Territory of New Guinea, including former German New Guinea (2453), New Britain Archipelago (former Bismarck Archipelago 2620), and that part of the Solomon Islands (2620) formerly owned by Germany.

II. NEW ZEALAND: **2499.**
- A. Position and Area:
  - a. **The Dominion of New Zealand** consists of two large islands (North Island and South Island) and a smaller island (Stewart Island) lying near the southern tip of South Island. The group is situated about 1,200 miles southeast of Australia. Attached to the Dominion of New Zealand are several small islands and island groups, of which the most important are the Aukland Islands, Chatham Islands, Cook Islands, and Kermadec Islands.
  - b. **The area of New Zealand** is about equal to that of the state of Colorado.
- B. Physiography and Climate: **2499.**
  - a. **North Island Consists of Plains and Plateaus Marked by Volcanic Cones and Hot Springs: 2499.**
  - b. **Rugged Cloud-Capped Peak of "Southern Alps" on South Island: 2499.**
  - c. **Climate:** Semi-tropical conditions prevail in the north, while the south is temperate. Rainfall is abundant everywhere.
- C. Resources and Products: **2499–2500.**
  - a. **Agriculture and Live Stock: Wheat, Oats, Barley, Hay, Sheep, Cattle, Hogs, Horses.**
  - b. **Forests and Forest Products: Lumber and Kauri Gum.**
  - c. **Fisheries: Whaling is an Important Industry 3724, 3725 (picture).**
  - d. **Minerals and Mining: Coal, Gold, Silver, Tungsten, Copper, Iron, Lead, Zinc, and Antimony.**
  - e. **Manufacturing: Wool, Leather, Meat Packing, Dairy Products, Clothing, Shoes, Metal Ware.**
- D. People of New Zealand:
  - a. **The Native Maoris and Their Characteristics: 2499.**
  - b. **Discovery and Colonization: 2499.**
- E. Chief Cities: **Wellington (capital), Auckland, Christchurch, Dunedin.**

III. PACIFIC ISLANDS: **2617.**
- A. General Physiography and Climate:
  - a. **Volcanic Islands and Coral Islands: 2621–2, 886, 3658, 1601, 3120, 1239.**
  - b. **Mild Healthful Climate: 2623, 1601–2; Hurricanes and Typhoons: 3366, 1239, 3120.**
- B. Resources and Products: **2622–3.**
  - a. **Wild and Cultivated Products:** Coconuts and Copra (818), Breadfruit (501), Sugar (3385), Pineapples (2809), Bananas (324), Taro, Yamp, Sago, Coffee, Rubber, Tea, Rare Woods.
  - b. **Sea Products:** Pearl Shell, Turtle Shell, Trepang or Bêche-de-mer (3165, 2623).
  - c. **Minerals:** Phosphate, Nickel (2506 picture).
- C. Peoples of the Pacific Islands:
  - a. **Traces of Prehistoric Races: 2618, 1070.**
  - b. **Native Types of Today — Melanesians, Micronesians, and Polynesians: 2620–1.**
- D. Principal Islands of the Pacific: **2624.**
  - a. **Melanesia: 2619–20.** Bismarck or New Britain Archipelago, Solomon Islands, and Santa Cruz (British); New Hebrides (British and French); New Caledonia and Loyalty Islands (French).
  - b. **Micronesia: 2620.** Marianas or Ladrones (Japanese except Guam 1545); Pelew Islands, Caroline Islands, and Marshall Islands (Japanese); Gilbert Islands (British).
  - c. **Polynesia: 2621–2.** Hawaiian Islands (United States) 1601; Fiji Islands (British) 1239; Samoan Islands (United States and British) 3120; Ellice Islands, Tokelau Islands, Tonga or Friendly Islands, and Cook Islands (British); Society Islands, Tubuai or Austral Islands, Marquesas, and Tuamotu or Low Archipelago (French).

Polar Regions

SURROUNDING each of the poles of the Earth is a region of extreme cold, where permanent settlement is difficult if not impossible. Alike as the two polar regions are in this respect, they differ in almost all other characteristics. The North Polar or Arctic Region consists for the most part of a great ocean into which are thrust the northern ends of Europe, Asia, and North America, together with various groups of islands large and small. The South Polar or Antarctic Region, on the other hand, consists chiefly of a vast and lofty land mass cut off by hundreds of miles of open water from the other continents. Human settlements have in many cases penetrated far within the Arctic Circle, while the Antarctic Region is entirely uninhabited.

I. ARCTIC REGIONS: **189.**
- A. Physiography and Climate:
  - a. **Arctic Ocean 189; Bering Strait 383, 228; Baffin Bay 189 (map), see also Fact-Index.**
  - b. **Chief Islands in Arctic Circle: 189–90, map next to page 602.** Greenland (1539), Spitzbergen (2534), Franz Josef Land, Nova Zembla, New Siberia, Nicholas II Land, Baffin Land, Banks Land, Victoria Land, Grant Land, Wrangel Islands.
  - c. **Arctic Plains or Tundras:** In North America 76, 2515, 2528, 603; In Europe 1191, 3086; In Asia 226, 3228.

- d. **North Magnetic Pole: 1690.**
- e. **Climate:** Extreme Cold, Sunless Winters 190, 1962; Midnight Sun 3394 (picture).

- B. Animals and Vegetation:
  - a. **Sea Life:** Whale 3723; Dolphin 1026; Seal 3166; Walrus 3668.
  - b. **Land Mammals:** Arctic Fox 1337; Polar Hare 1585; White Wolf 3774; Polar Bear 355; Wolverine 3776; Ermine 1174; Musk Ox 2383.
  - c. **Reindeer, the Domestic Animal of the North: 2993.**
  - d. **Birds:** Auk 258, 1090; Eider Duck 1046; Penguins 2864; Puffin 259, 413; Ptarmigans 1544; Sandpiper 414, 3261; Snow Bunting 534, 411; Snowy Owl 2607; Tern 1549; Teal 1044.
  - e. **Vegetation: 190;** Lichens and Mosses 1994.
- C. **Natives of the Arctic Regions: Eskimos 1174; Lapps 1962.**
- D. **Natural Resources and Industries: Fur-Bearing Animals 190, 1692; Fishing 190; Whaling 3724; Sealing 3166; Walrus Hunting 3668; Coal 190, 2534.**
- E. North Polar Explorations:
  - a. **Some of the Chief Explorers and Their Work: 2859, 110, 120, 617, 384, 312, 119.**
  - b. **Robert E. Peary the First Man to Reach the North Pole: 2703.**

II. ANTARCTIC REGIONS: **145.**

- A. Physiography and Climate:
  - a. **High Plateaus and Lofty Mountains: 145; Average Elevation as Compared with other Continents: 2791** (diagram).
  - b. **South Magnetic Pole: 1064.**
  - c. **Severe Antarctic Climate because of Altitude and Land Mass: 145.**
- B. Animals and Vegetation:
  - a. **Only Few Birds Can Bear the Rigorous Climate:** Penguin 2864; Petrel 2747; Albatross 80.
  - b. **Sea Mammals:** Seal, Sea-Lion, Sea-Elephant 3166; Whales 3723; Dolphin 1026.
  - c. **Vegetation:** Mosses and Lichens 1994, 145.
- C. South Polar Explorations: **2862.**
  - a. **Captain James Cook first to Penetrate the Antarctic Circle: 874.**
  - b. **Achievements and Heroism of Robert F. Scott: 3149.**
  - c. **Roald Amundsen first to Reach South Pole: 119.**

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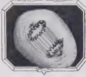
In what part of the world is "today yesterday and yesterday today"? 79 (picture).
What single river basin is almost as large as the United States? 105 (picture).
Which is the longest mountain system on earth? 122.
How did a cruel robber chief give Antwerp its name? 152.
What country is supported by gambling? 2313.
What North American seaport is nearly 1,000 miles from the sea? 2317.
What country has almost as many canals as railroads? 2438.
What French port was benefited most by the opening of the Suez Canal? 2154.
What American city gave its name to the fastest type of commercial sailing ship? 2162.
What American state was founded as a refuge for persecuted Catholics? 2163.
What states are separated by the "Mason and Dixon" line? 2164.
What state produces almost half the shoes used in the United States? 2165.
Where is the largest watch factory in the world? 2166.
What city is the greatest "mill town" for textiles in America? 2166.
How did her rivers shape the economic life of Massachusetts? 2169.
What kingdom is political ruler of Mecca? 2187.
Where is meerschaum found and where manufactured? 2194.
What sea was the first to be navigated by white men? 2194.
What is the "Levantine Sea"? 2194.
What town is the center of America's greatest muskmelon district? 2195.
What European country grows many watermelons? 2196.
Why is Mesopotamia, once a garden spot, all but desert now? 2200.
What important French river flows through a natural tunnel for three miles? 2207.
What country is probably the richest in undeveloped mineral resources? 2208.
Where do we get binder twine for American harvesting machines? 2214.
Which American state has the longest coast line? 2223.
What American state furnishes most of the world's peppermint? 2224.
What city is called the "automobile capital of the world"? 2224.
What city is the world's greatest flour center? 2252.
In what state do the iron mines contribute directly to the support of schools? 2256.
What river of the United States maintains its surface higher than the land on either side? 2266.
In what American state is it said that "east meets west, and north meets south"? 2270.

BIOLOGY



THE most wonderful thing in the world is Life. Since the earliest days of civilized thought philosophers have wondered at its manifold problems and have sought in vain to penetrate its mysteries. What is Life? What is that magic thing, possessed alike by the tiniest plant and the greatest genius among men, which serves to set them apart from the "dead" rock of the hillside? We are perhaps very little nearer to a final definition of Life than were the old Greek sages. Yet of the facts *about* Life we know vastly more. It is with these facts that Biology deals. It was not until the beginning of the last century that Biology was organized definitely as a separate science. About that time the knowledge of Botany and Zoölogy, Anatomy and Physiology had developed far enough to suggest to scientists that certain great principles must run through *all* forms of Life, whether plant or animal. Setting about to discover and formulate those principles, they founded the science of Biology.

In the earlier Outline on Nature Study we have examined many of the most interesting and significant facts about plants and animals, without, however, emphasizing any general biological laws. Here we shall survey briefly the scope of Biology as a science, and examine some of the more important characteristics common to all forms of life, without attempting to go far into technical details. Following this general survey, the student will find, under "Botany" and "Zoölogy," scientific classifications of plants and animals, so arranged and explained as to bring out many of the significant relationships existing between the members of each group.

I. THE SCOPE OF BIOLOGICAL SCIENCE:

A. Biology is the Science of All Life: 393.

- **a. Botany is Biology Applied to Plant Life (473); Zoölogy is Biology Applied to Animal Life (3841).**
- **b. Relations of Biology to Other Sciences:**
  - **1. Chemistry** supplies data and methods for studying substances involved in life (food, tissues, fluids, such as blood and the saps of plants). An example is the chemistry of digestion (1010). This aspect of chemistry is often called Organic Chemistry (714), or because carbon occurs so universally throughout living tissues, the Chemistry of Carbon Compounds (642). A more definite term—**Biochemistry**—is coming into use, however, to describe the specific chemistry of life's processes.
  - **2. Physics** supplies data and methods for studying the effects upon life of physical states and forces, such as light, heat, electricity, etc. For instance, Physics helps to tell why sap rises (2825, 2823 picture).
  - **3. Geology** supplies data concerning how the "life environment," that is the earth's crust, the air, the waters of the earth, came to have its present form. It helps to trace the history of life by studying the age of fossils (1322, 1209, 1418). This union of Geology with Biology is often given a separate name—**Paleontology** (1336).

B. Chief Subdivisions of Biology:

- **a. Cytology** deals with the composition and structure of Cells (671), the basic units from which all living things are built; **Histology** (121) deals with the manner in which these Cells are organized into living tissues; **Anatomy** (121) investigates the arrangement of tissues into organs, and the arrangement of organs in the living organism.
- **b. Embryology** (1140) studies the development of individual organisms from the first single cell; **Morphology** (121) applies the principles of the foregoing branches to a study of the causes governing the structure and forms of all living organisms; **Physiology** (2792) investigates and describes the functions of the parts of the organisms.
- **c. Ecology** (1076) deals with the relations of plants and animals to their environment, the effects of climate, etc.
- **d. Genetics** (398, 473) includes the study of the laws governing heredity in plants and animals. **Eugenics** (1187) is a branch or outgrowth of Genetics.

II. BIOLOGY'S TEACHINGS—THE LIFE PROCESS:

- **A. Things Necessary to Life:**
  - **a. Chemical Elements:** From 12 to 16 elements only, out of the 82 elements of which the earth is composed, are required by living organisms (394). These are Carbon, Oxygen, Hydrogen, Nitrogen, Iron, Sulphur, Phosphorus, Chlorine, Potassium, Sodium, Magnesium, Calcium, Manganese, Fluorine, Silicon, and Iodine.
  - **b. Water Essential to Life: 3693.**
  - **c. Heat and Light Essential to Life: 2000.**
- **B. Combination of Matter into Life Forms:**
  - **a. The Cell is the Combining Unit:** The Cell is the unit of all tissue (398, 671). Many primitive plants and animals consist of single cells, as Amoeba (118), Bacteria (302). Higher forms start as single cells in the reproductive process and grow by cell-division (394, 395 picture).
  - **b. Chemical Nature of Cells:** Protoplasm (2926) is the universal material (2926). Plant structures are stiffened with Cellulose (673), Animal structures usually with compounds of Calcium and Silicon.
  - **c. Basic Chemical and Physical Processes:**
    - **1.** Life materials are obtained from lifeless air, earth, and water by the process of "Photosynthesis." This is the scientific name of the process by which plants with the aid of sunlight use their green coloring matter (chlorophyll) to extract carbon from the carbon-dioxide of the air, and then combine that carbon with the minerals and water from the earth to manufacture the materials from which plant cells are built (2823, 1980).
    - **2.** Plants alone possess the chlorophyll necessary for Photosynthesis. Animals live directly or indirectly on the food manufactured by Plants.
    - **3.** Many life processes are carried out through the action of Enzymes (1173).
  - **d. Food Absorption and Conversion:**
    - **1.** Single-Celled Animals and Plants obtain their food by absorbing it through the Cell walls (118). Many-celled types usually have some kind of container into which food is drawn and held while being absorbed.
    - **2.** Chemical Nature of Food Conversion—by chlorophyll in Plants (2824); by digestive ferments in Animals (1010).
  - **e. Distribution of Food:**
    - **1.** Circulation of sap in higher Plants: 2825, picture 3531
    - **2.** Circulation of blood in Animals: 437.
  - **f. Respiration Necessary to All Forms of Life: 2998, 2824.**
  - **g. Indirect Ways of Obtaining Life Substances:**
    - **1. Parasitism,** living upon body material of another living organism: 2677, 2823. Typical parasites among worms (3813, 396); among plants (rusts and smuts 3099). Usually accompanied by degeneration of the Parasite (2678).
    - **2. Saprophytism,** living upon material of dead organisms: 2823. Mushrooms (2374) are typical plant saprophytes. In one sense, of course, all animals, living as they do upon the food manufactured by plants, are Saprophytes.
    - **3. Symbiosis,** combination of two forms of life into a partnership, each carrying on a separate share of the life process. The Lichens (1994) are examples. Sometimes the partners are called Commensals or "messmates" (912).
  - **h. Disposing of Used and Waste Materials:**
    - **1. By excretion: 1011, 1922.**
    - **2. By respiration: 2998.**
- **C. Organization of Life Processes:**
  - **a. Life Processes are Carried Out Only through Individual Organisms:** It is characteristic of all the phenomena of life that they are invariably found associated with individuals *functioning as units.* The parts of each unit are so coördinated that they act together toward a common end.
  - **b. Coördinating Mechanism of Plants:** Little is known of the forces which control this feature of plant life. The manner in which the various parts of a great tree, for instance, "communicate" with each other so that each performs its proper part in relation to the whole tree is still a mystery: —Evidence of Delicate Coördination in Plants: 2828, 2824 picture; Sensitive Plant 2829.
  - **c. Coördinating Mechanism in Animals:** The very low types of animals, such as Sponges, present the same mystery in this respect as do plants. But, beginning with the Jelly-fish, there appears a distinct equipment definitely suited for the coördinating process—that is a Nervous System.
    - **1.** Nerves and Their Work: 2436.
    - **2.** Nervous Systems of Higher Animals Culminate in the Brain: Man's brain (486) is the highest development of the coördinating mechanism.
- **D. Reproduction of Life:**
  - **a. Asexual Reproduction:** This consists of a simple division of the single organism into two parts. This type of reproduction is found only among lower organisms such as Bacteria (303), Amoeba (119). It may take place either:
    - **1. By Fission** or "splitting apart" into two equal or nearly equal parts, as in the case of Amoeba and of many Bacteria, or

2. **By Gemmation,** also called "budding" or "sporing," in which the original organism puts forth a "bud" or "spore" which grows and eventually comes away. Yeast (3828 picture) is an example.

b. **Sexual Reproduction:** This type requires two parent bodies. It consists of the union of two reproducing cells or **Gametes,** one from each parent. Often the two parent bodies are found upon the same individual, as in the case of most flowers (1304).

1. Male cell is called Sperm.
2. Female Cell is called Ovum or Egg.

c. **Reproduction by Alternating of Generations:** Many organisms reproduce by a process which combines the asexual and the sexual method. The process in plants consists of (1) the asexual production of a spore; (2) the growth of the spore into a "gametophyte" or sex plant; (3) the sexual production by the gametophyte of a "sporophyte" or non-sexual plant, which in turn produces spores again by the asexual process. Examples of this process seen in Mosses (2338) and Ferns (1232).

E. **Development of New Life:**

a. **Embryology: 1140.**

b. **Egg: 1090: Seeds and Spores 3171.**

III. HISTORY OF LIFE:

A. **Evolution: 1208.**

a. **Darwin's Theory: 963.**

b. **What Geology Tells Us of Evolution: 1418.**
—The Story of Fossils: 1334.

c. **Some Examples of Evolution:** Horse (1682), Elephant (1126 picture), Flatfish (1289).
—Survival of primitive types: Marsupials as examples (1908).

B. **Heredity and what It Means: 1641.**

BOTANY

Classification of Plants

COUNTLESS difficulties confront botanists in the classification of plants and the various writers on the subject differ in their arrangements in many points. But such differences are not important to the general student. The classification made here is based upon the work of the most recent authorities. It does not pretend to be complete, but to include only those groups which are either of great scientific importance or well known to the general public.

The group names used in the descending order are Phylum, Sub-phylum, Class, Order, Family, Genus. In each case the Phylum is indicated by a Roman numeral (I, II, III, etc.), the Sub-phylum by "Sub-ph.," and the others by the following abbreviations: "Cl., Ord., Fam., Gen." An explanation of the meaning of these group names is given on page 412.

I. **THALLOPHYTES:** Simplest plants, usually distinguished by having a "thallus" body, that is a body which has no differentiated organs such as flowers, sap fibers, leaves, roots, etc. Forms range from microscopic size to such enormous growths as the giant kelp. Most types reproduce asexually, that is by simple division, but higher types have primitive sexual characteristics.

Sub-ph. **ALGAE: 90.** Includes those Thallophytes which have green coloring matter (chlorophyll). Regarded as ancestors of all higher plants.

Cl. **Chlorophyceae:** "Green Algae"; simple one-celled forms; they contain no coloring matter other than chlorophyll (92).

Ord. **Volvocales:** Single celled plants capable of moving about with the aid of "cilia" or vibrating hair-like organs. Often gathered in colonies in ponds. Reproduction is sexual. Zoologists usually class some of these forms as animals in the group Flagellata. Typical genus: *Volvox.*

Ord. **Protococcales:** One-celled, asexual, motionless forms. Typical genera: *Pleurococcus,* Green Slime, often found in colonies on damp stones, tree trunks; *Hydrodictyon,* Water Nets, forming net-like colonies sometimes a foot long.

Ord. **Confervales:** Many-celled body, branching or sheet-like. Reproduction is sexual. Typical genera: *Ulothrix,* a fresh-water form which reproduces by pairing gametes or sexual cells of similar stucture; *Oedogonium,* a fresh-water form with gametes differentiated into egg and sperm cells; *Ulva,* Sea Lettuce (3170 picture).

Ord. **Siphonales:** Lack of cross-walls in body gives continuous cavity. Typical genus: *Vaucheria* (pond-scum, often called "green felt").

Ord. **Conjugales:** Reproduces by sexual gametes which fuse through tubes instead of swimming toward each other. Typical genus: *Spirogyra,* pond-scum which gathers into delicate filaments (92).

Ord. **Charales:** "Stoneworts"; grow on bottom of ponds. Thallus has definite points from which branches and reproducing cells originate.

Cl. **Rhodophyceae:** "Red Algae" (92); structure simpler than that of other algae, but sexual reproduction more highly developed.

Cl. **Phaeophyceae**: "Brown Algae," chiefly marine (92). Includes Ord. **Laminariales**, the Kelps; Ord. **Fucales**, the Rockweeds (3170 picture), and Gen. *Sargassum*, the Gulfweed (3170).

Note: The Class **Chaenophyceae** or so-called "Blue-green Algae" are placed by most recent botanical works in the Sub-phylum Schizomycetes, which includes also Bacteria. (See below.)

Sub-ph. **FUNGI: 1382**. Parasitic and saprophytic forms, lacking chlorophyll. Characterized by the **mycelium**, consisting of a network of thread-like filaments (hyphae) which permeate food supply, or give rise to the visible spore-producing organs. Believed to have degenerated from Algae, having lost their chlorophyll and hence their ability to manufacture their own food.

Cl. **Phycomycetes**: Resemble green algae; mycelium has continuous cavity, with no cross-walls. Includes Downy or "False" Mildews and Black Molds (2235).

Cl. **Ascomycetes**: Mycelium divided by cross-walls; spores borne in sacs. Includes Yeasts (3828), Morels (2375), Truffles (2375), Ergot (3102), and the true Mildews and Molds (2235).

Cl. **Basidiomycetes**: Spores borne on stalk called "basidia." Typical examples Rusts and Smuts (3099), Mushrooms (2374).

Note: The class **Myxomycetes** or Slime Molds are sometimes included with the Fungi because they possess spore cases. They do not, however, have the mycelium. The young swarm cells gather into amoeba-like groups, which leads some biologists to class them as animals under the name Mycetozoa (see Zoölogy Outline under division on Protozoa).

Sub-ph. **SCHIZOMYCETES**: Fission Fungi; single-celled body; reproduce by fission instead of "sporing." Includes Bacteria and "Blue-green Algae." Read also Germ Theory of Disease (1449).

Note: The **Lichens** are partnership plants, consisting of a Fungus which imprisons Algae, forming a combination that is mutually helpful. Lichens can be made artificially by placing the proper plants together. They are usually classified by means of the Fungus which enters into the combination. For instance, the genera *Parmelia* and *Physcia* are **Ascolichenes**, because the Fungus is an Ascomycete.

II. BRYOPHYTES: Forms evolved from Green Algae and adapted to land life. Characterized by well developed "alternation of generations," in which the gametophyte (plant of the sexual generation) is the commonly visible form.

Cl. **Hepaticae**: Liverworts (2032) evolved from Algae and ancestors of Mosses; spore case opens by splitting.

Cl. **Musci**: Mosses (2338) evolved from Liverworts; spore case opens by means of a lid; plant differentiated into primitive stems and leaves. The Mosses are divided into three orders: **Sphagnales**, single genus *Sphagnum*, the Bog-mosses adapted to aquatic life; **Andreales**, rock-growing forms; **Bryales**, soil-growing forms, typified by genus *Funaria*.

III. PTERIDOPHYTES: This group is characterized by the appearance of a **Vascular Structure**, that is a system of vessels for conducting sap through the plant body. Reproduction is by alternating generations as in Bryophytes, but in this case the sporophyte (asexual generation) is the commonly visible form. The class relationships between the members of this phylum are still obscure. There are, however, three distinct orders:

Ord. **Equisetales**: Composed of only one genus, *Equisetum*, the Horsetails (3083, 1234); stems jointed; leaves grow in whorls, being united in each whorl into a sheath.

Ord. **Lycopodiales**: Club-mosses (1234); have slender branching stems, completely clothed in small foliage leaves, having a general moss-like appearance.

Ord. **Filicales**: Ferns (1232); large leaves which bear spores in "sori" or spore-cups on their under surface. Divided into two sub-orders: **Filicineae**, the true Ferns, and **Hydropteridineae**, the Water Ferns.

IV. SPERMATOPHYTES: Seed Plants, that is plants in which the fertilization of the female cell by the male cell results in the production of a **Seed**, as distinguished from the three preceding groups which either reproduce by simple division or which grow directly from the union of two spores (3173). Spermatophytes are divided into two great sub-phyla: (1) the **Gymnosperms** or "naked-seeds," referring to the fact that the seeds are always exposed; and (2) the **Angiosperms** or "enclosed seeds" indicating that the seeds are inclosed in a seed vessel. The former are regarded as the more primitive types.

Sub-ph. **GYMNOSPERMS**:

Ord. **Cycadales**: Cycads (3533); fernlike tropical types, strongly suggesting the probable fern ancestry of all Gymnosperms. Single stem, crowned by few large leaves. Typified by genus *Zamia* (American) and *Cycas* (Asiatic).

Ord. **Ginkgoales**: Typified by genus *Ginkgo*, the Ginkgo (1460).

Ord. **Coniferales**: Conifers; temperate types; long straight trunk; cone-bearing, and usually evergreen, with needle-like leaves.

Fam. **Pinaceae**: Ovules protected by overlapping scales; seeds ripen dry. Includes the following genera: *Pinus*, Pine (2807); *Abies*, Fir (1248); *Picea*, Spruce (3332); *Tsuga*, Hemlock (1629); *Sequoia*, Sequoias, Redwoods (3175); *Juniperus*, Junipers (1902, 671); *Cedrus*, Cedar (670); *Larix*, Larch (1962); *Thuja*, Arbor Vitae (671, 670, picture); *Cupressus*, Yellow Cedar, Lawson Spruce (946); *Taxodium*, Bald Cypress (946); *Taxus*, Yew (3830).

Fam. **Taxaceae**: Ovules often unprotected by scales; seeds frequently ripened in fleshy capsules. Found in Southern hemisphere, where they take the place of conifers of the North. Principal genus, *Podocarpus*.

Sub-ph. **ANGIOSPERMS:** The highest of the great plant divisions. Members of this group have true flowers; seeds are enclosed in seed case. Angiosperms fall into two great classes: **Monocotyledons,** whose seeds contain but one "cotyledon" or seed-leaf, and **Dicotyledons** whose seeds contain more than one "cotyledon."

Note: The classification of Angiosperms depends chiefly upon the development of their flowers. They are ranked according to variations in the following characteristics:

- **A.** The **perianth** which consists of the corolla formed by the petals and of the calyx formed by the sepals (1305). The perianth may be lacking altogether; or there may be a **"bracteate"** perianth, composed of bracts or sheaths protecting the flower; or there may be a true perianth, composed of both corolla and calyx.
- **B.** The parts of the flower may be distributed about their axis in a spiral of varying length, in which case the flower is said to be **"spiral"**; or they may be arranged in definite cycles of regular pattern, in which case the flower is said to be **"cyclic."**
- **C.** The sepals, petals, and stamens may arise from beneath the ovary, in which case the flower is **"hypogynous"**; or they may arise from the side of the ovary, in which case the flower is **"perigynous"**; or they may arise from above the ovary, in which case the flower is **"epigynous."**
- **D.** The carpels (consisting of the ovaries and pistils) may each be separate from the other, in which case the flower is **"apocarpous"**; or the carpels may unite to form a single compound pistil, in which case the flower is **"syncarpous."**
- **E.** Each petal may be separate, in which case the flower is **"polypetalous"**; or the petals may fuse into a tubular corolla, in which case the flower is **"sympetalous."**
- **F.** When stamens and pistils exist in the same flower, it is **"bisexual"**; when they exist in separate flowers, these flowers are **"unisexual,"** one flower being **"staminiferous"** or male, the other **"pistilliferous"** or female. When male and female flowers are found on the same plant, the plant is **"monoecious"**; when on separate plants, the plants are **"dioecious."**
  - Cl. **Monocotyledons:** Seeds have only one cotyledon; flowers spiral or cyclic; vascular tissue (3532) usually scattered through the stems, instead of forming a tube or belt enclosing pith, as in the Dicotyledons; leaves are mostly parallel veined or "net-veined," that is the veins either start at the base and run to the tip without branching (1981 picture), or they form a closed network, while in the leaves of the Dicotyledons, the veins usually branch out and end at the margin.
    - Ord. **Pandalales:** Spiral flowers; perianth lacking; all forms water-loving. Typical Example: Fam. **Typhaceae,** Gen. *Typha,* Cat-tail (3700).
    - Ord. **Glumales:** Individual flowers protected by bracts, called "glumes" in such a formation.
      - Fam. **Poaceae or Gramineae:** Grass family (1502); includes most cereal grains. Typical genera: *Avena,* Oats (2548); *Triticum,* Wheat (3730); *Secale,* Rye (3102); *Oryza,* Rice (3013); *Hordeum,* Barley (330); *Zea,* Corn (888); *Andropogon,* Kafir corn (1907), Sorghum (3276); *Panicum,* Millet (2239); *Bambusa,* Bamboo (323); *Saccharum,* Sugar Cane (3386).
      - Fam. **Cyperaceae:** Sedges (3171). Distinguished from grasses by solid leaf-sheath which encloses stem. Typified by genus *Carex,* Common Sedge.
    - Ord. **Palmales:** Consists of one family, **Palmaceae,** the Palms (2647); rudimentary perianth present; flower cluster sheltered by great bract. Typical genera: *Phoenix,* Date Palm (966); *Areca,* Betel (387); *Cocos,* Coconut (818); *Metroxylon,* Sago Palm (3104).
    - Ord. **Arales:** Flowers with highly specialized type of bract; broad, net-veined leaves.
      - Fam. **Araceae:** Arums, Typical genera: *Caladium,* Caladium (3700); *Richardia,* Calla Lily (2009).
      - Fam. **Lemnaceae:** Duckweeds (3700); stemless, whole plant resembling simple frond.
    - Ord. **Farinales:** Flowers of primitive cyclic form; bracts persist, but differentiated calyx and corolla appear in higher forms. Seeds starchy.
      - Fam. **Pontederiaceae:** Pickerel Weeds; aquatic, with sheathing leaves and perfect flowers developed from large bract. Typical genera: *Eichornia,* Water Hyacinth (1706); *Pontederia,* Pickerel Weed (3700).
      - Fam. **Commelinaceae:** Spiderweeds. Typical genus: *Zebrina,* Wandering Jew (3669).
      - Fam. **Bromeliaceae:** Bromelia family; most types air-living (epiphytic 69); leaves often scaly. Typical genera: *Tillandsia,* Spanish Moss (69); *Ananas,* Pineapple (2809).
    - Ord. **Lileales:** Perianth varies from primitive types in lower families to petal-like type in higher groups; seeds oily rather than starchy.
      - Fam. **Liliaceae:** Floral elements set below ovaries (hypogynous); regarded as more primitive than families following. Typical genera: *Lilium,* Common Lilies (2008); *Allium,* Onion (2581), Garlic, Leek; *Asparagus,* Asparagus (234); *Convallaria,* Lily of the Valley (2009); *Tulipa,* Tulips (3547); *Smilax,* Smilax, Sarsaparilla (3127); *Yucca,* Yucca, Bear-grass (3835), Spanish Bayonet; *Erythronium,* Dog-tooth Violet (1025); *Trillium,* Trillium (3540).
      - Fam. **Juncaceae:** Rushes (3083). Flowers resemble lilies but are clustered; suited to wind pollination; leaves grasslike.
      - Fam. **Dioscoreaceae:** Tuber roots, climbing stems. Typical genus: *Dioscorea,* Yam (3406).

- Fam. **Amaryllidaceae:** Amaryllis family, floral elements rise from top of ovary (epigynous). Typical genera: *Narcissus*, Narcissus, Jonquil, Daffodil (2397); *Agave*, Agave, Sisal (3244), Century Plant (42); *Polianthes*, Tuberoses (3547).
- Fam. **Iridaceae:** Iris family; most highly specialized of Lileales; flowers epigynous. Typical genera: *Iris*, Iris (1814); Gladiolus (1466); *Crocus*, Crocus (923); *Hyacinthus*, Hyacinth (1706).

Ord. **Scitaminales:** Flowers have petal-like stamens; sheaths of leaves build up false stem.

- Fam. **Musaceae:** Banana family. Typical genus: *Musa*, Banana (324).
- Fam. **Cannaceae** or **Scitaminaceae:** Canna family. Typical genus: *Canna*, Canna (630).
- Fam. **Zinziberaceae:** Ginger family. Typical genera: *Zinziber*, Ginger (1460); *Maranta*, Arrowroot (220).

Ord. **Orchidales:** Most highly specialized of all Monocotyledons. Most types contained in family **Orchidaceae.**

- Fam. **Orchidaceae:** Contains "air plants" (epiphytes) and land forms, the latter usually saprophytic or parasitic. Most flowers have one petal developed into labellum, or "lip." Typical genera: *Orchis*, including many of the best known orchids (2593); *Cattleya* (2592, picture); *Cypripedium*, Lady's Slipper (1955); *Vanilla*, Vanilla (3619).

Cl. **Dicotyledons:** Plants whose seeds consist of two cotyledons. Vascular tissue (3532) forms tube or belt including central pith; leaves usually "open-veined," that is, veins end at edge of leaf.

Note: The Dicotyledons fall into two subclasses, (1) the **Archichlamydeae,** in which the corolla is either lacking (apetalous) or composed of several separate petals (polypetalous), and (2) the **Sympetalae** in which the petals are fused into a cup or tube at the base (sympetalous). The classification begins with the Archichlamydeae:

Ord. **Piperales:** Primitive form; naked flowers. Typified by family **Piperaceae,** genus *Piper*, Pepper (2723).

Ord. **Salicales:** The Willow order with one family; flowers grow on aments or "catkins," consisting of long, fleshy spikes bearing numerous simple flowers, each flower concealed by a horny sheath or bract.

- Fam. **Salicaceae:** Typical genera *Salix*, Willow (3742); *Populus*, Poplar (2879), Aspen, Cottonwood.

Ord. **Juglandales:** The Walnut order, with one family. Flowers in catkins similar to willows, but show beginnings of petal and sepal structure; compound leaves (i.e., leaves composed of several leaflets).

- Fam. **Juglandaceae:** Flowers monoecious (1305). Typical genera: *Juglans*, Walnut (3667), Butternut (548); *Hicoria*, Hickory (1647), Pecan (2705).

Ord. **Fagales:** Flowers in catkins similar to those of the Walnut order, but leaves simple (i.e., not composed of leaflets).

- Fam. **Fagaceae:** Typical genera: *Fagus*, Beech (364); *Quercus*, Oak (2547); *Castanea*, Chestnut (718), Chinquapin (752).
- Fam. **Betulaceae:** Typical genera: *Betula*, Birch (399); *Corylus*, Hazel (1611); *Alnus*, Alder (85).

Ord. **Urticales:** Perianth distinct but bracteate instead of having true petals and sepals; flowers cyclic.

- Fam. **Urticaceae:** Nettle family; alternate leaves. Typical genera: *Urtica*, Nettle (2443); *Humulus*, Hop (1680); *Brosimum*, Cow Tree (3532).
- Fam. **Ulmaceae:** Elm family; alternate, simple leaves. Typical genus: *Ulmus*, Elm (1138).
- Fam. **Moraceae:** Mulberry family. Typical genera: *Morus*, Mulberry (2365); *Toxylon* or *Maclura*, Osage Orange (1627); *Cannabis*, Hemp (1630); *Ficus*, Fig (1237), Common Rubber Plant (3073), Banyan (329); *Castilloa*, Central American Rubber Tree (3072); *Artocarpus*, Breadfruit (501).

Ord. **Santalales:** Flowers cyclic as in above order but calyx and corolla are differentiated.

- Fam. **Santalaceae:** Typical genus: *Santalum*, Sandalwood (3123).
- Fam. **Loranthaceae:** Mistletoe family (2274); most members tropical and parasitic. Typical genera: *Viscum*, European Mistletoe; *Phoradendron*, American Mistletoe.

Ord. **Polygonales:** Flowers cyclic; "three part" perianth.

- Fam. **Polygonaceae:** The Dock family. Typical genera: *Polygonum*, Knotweed; *Rumex*, Dock (3013); *Rheum*, Rhubarb (3012); *Fagopyrum*, Buckwheat (524).

Ord. **Centrospermales:** Transitional forms ranging from bracteate flowers of family **Chenopodiaceae** to completely developed corolla and calyx of **Caryophyllaceae.**

- Fam. **Chenopodiaceae:** Goosefoot family; leaves adapted to avoid evaporation of water. Typical genera: *Chenopodium*, Goosefoot Weed; *Beta*, Beet (365).
- Fam. **Phytolaccaceae:** Typical genus: *Phytolacca*, Pokeberry (2854).
- Fam. **Amarantaceae:** Typical genus: *Amarantus*, Amaranth.
- Fam. **Caryophyllaceae:** Pinks; flowers well developed with calyx tending to fuse into tube in some types. Typical genera: *Silene*, Fire Pink (2809); *Dianthus*, Pink (2809), Carnation (645), Sweet-William (2809).

- Ord. **Ranales:** In this order are found primitive types, with apocarpous, hypogynous, and spiral flowers, and well developed types, with cyclic flowers having true perianth.
  - Fam. **Ranunculaceae:** Crowfoot family. Typical genera: *Ranunculus*, Buttercup (544); *Delphinium*, Larkspur (1963); *Paeonia*, Peony (2722); *Clematis*, Clematis (786); *Helleboras*, Hellebore (2852); *Aquilegia*, Columbine (846); *Hepatica*, Hepatica (1639); *Caltha*, Marsh Marigold (2155); *Aconitum*, Monk's Hood (2855); *Anemone*, (123).
  - Fam. **Berberidaceae:** Typical genera: *Berberis*, Barberry (1628); *Podophyllum*, May-Apples (2175).
  - Fam. **Nymphaeaceae:** Typical genera: *Nymphaea*, Yellow Pond Lily (3699); *Castalia*, White Water Lily (3699), Sacred Lotus (2063).
  - Fam. **Magnoliaceae:** Magnolia family. Typical genera: *Magnolia*, Magnolia (2123); *Liriodendron*, Tulip Tree (3547).
  - Fam. **Myristicaceae:** Nutmeg family; tropical trees and shrubs. Typical genus: *Myristica*, Nutmeg (2544).
  - Fam. **Lauraceae:** Laurel family. Typical genera: *Laurus*, Laurel (1970), Bay Tree; *Cinnamomum*, Cinnamon (3318); *Camphora*, Camphor (594); *Sassafras*, Sassafras (3129).
- Ord. **Rhoedales:** Includes forms developed from Water Lily family, **Nymphaeaceae.** The Poppies (Fam. **Papaveraceae**) are the parent stock of the order, the other families having evolved from them. Flowers more advanced than most of the Ranales.
  - Fam. **Papaveraceae:** The Poppy family. Typical genera: *Papaver*, Poppy (2880); *Sanguinaria*, Bloodroot (438).
  - Fam. **Resedaceae:** Typical genus: *Reseda*, Mignonette (2230).
  - Fam. **Brassicaceae:** The Cabbage family (554). Typical genera: *Brassica*, Cabbage, Cauliflower, Turnip, Mustard, Brussels Sprouts (553); *Raphanus*, Radishes (553); *Lepidium*, Water Cress (553).
- Ord. **Sarraceniales:** In this order are included many insect-catching plants.
  - Fam. **Sarraceniaceae:** American forms. Typical genus: *Sarracenia*, "Side Saddle" (2811).
  - Fam. **Nepenthaceae:** Asiatic forms; pitchers at tip of tendrils. Typical genus: *Nepenthe*, Pitcher Plant (2811).
  - Fam. **Droseraceae:** Leaves exude sticky fluid. Typical genera: *Drosera*, Sundew (3396); *Dionaea*, Venus's Fly-Trap (3626).
- Ord. **Rosales:** This is the dominant order in the sub-class **Archichlamydeae,** with over 14,000 species. Flowers cyclic with traces of lower spiral form; fruits highly specialized. Types supposed to have evolved from Buttercup family, **Ranunculaceae.**
  - Fam. **Saxifragaceae:** Most primitive types; regarded as ancestors of other families in the order. Typical genera: *Saxifraga*, Saxifrage (3131); *Hydrangea*, Hydrangea (1708); *Philadelphus*, Syringa (3426).
  - Fam. **Rosaceae:** The Rose family. Typical genera: *Spirea*, Spirea (3327); *Rosa*, Rose (3066); *Fragaria*, Strawberry (3370); *Rubus*, Raspberry (2977), Blackberry (432), Loganberry (2046); *Prunus*, Apricot (161), Plum (2840), Peach (2699), Sloe (3251), Cherry (716); *Amygdalus*, Almond (99); *Crataegus*, Hawthorn (1607); *Cydonia*, Quince (2950); *Pyrus*, Pear (2701), Apple (160); *Sorbus*, Mountain Ash (2357).
  - Fam. **Fabaceae** or **Leguminosae:** Pod-bearing plants; roots often harbor nitrifying bacteria (302): Genus *Mimosa* is typical of the stock from which other types of Fabaceae evolved. This family is divided into three subfamilies according to flower structure.
    - Sub-fam. **Mimosoideae:** Tropical and semi-tropical forms; corolla regular. Typical genera: *Mimosa*, Mimosa or Sensitive Plant (2829); *Proposis*, Mesquite (2201); *Acacia*, Acacia (4).
    - Sub-fam. **Caesalpinioidae:** Flower partially "papilionaceous," that is butterfly-shaped. Typical genera: *Gleditsia*, Honey Locust (1627); *Tamarind*, Tamarind (3432); *Circis*, Judas Tree (1901).
    - Sub-fam. **Papilionoidae:** Flower completely papilionaceous. Typical genera: *Phaseolus*, Bean (347); *Glycine*, Soy Bean (3297); *Pisum*, Pea (2698); *Lothyrus*, Sweet Pea (3405); *Vigua*, Cowpea (910); *Lentilla*, Lentil (1988); *Aracis*, Peanut (2700); *Trifolium*, Clover (809), Shamrock (3195); *Melilotus*, Sweet Clover (809); *Lespedeza*, Japanese Clover (810); *Medicago*, Alfalfa (88); *Astragalus*, Milk Vetch, Loco Weed (3712), Tragacanth (1552); *Glycyrrhiza*, Licorice (1995); *Lotus*, Lotus (2063); *Robinia*, Locust (2045); *Indigofera*, Indigo (1777); *Wisteria*, Wistaria (3773); *Haemotoxylon*, Logwood (2046).
  - Fam. **Platanaceae:** Typical genus: *Platanus*, Sycamore (3424).
  - Fam. **Hamamelidaceae:** Typical genus: *Hamamelis*, Witch Hazel (3774).
  - Fam. **Grossulariaceae:** Typical genus: *Grossularia*, Gooseberry (1488).
- Ord. **Geraniales:** Flowers completely cyclic; carpels tend to fuse into "compound pistils" in higher families such as **Melinaceae.**
  - Fam. **Geraniaceae:** Geranium family. Typical genera: *Pelargonium*, so-called "Geranium" (1435); *Geranium*, true Geranium (1435).

- Fam. **Tropaeolaceae:** Typical genus: *Tropaeolum*, Nasturtium (2398).
- Fam. **Linaceae:** Typical genera: *Linium*, Flax (1291); *Erythroxylon*, Coca (2742).
- Fam. **Meliaceae:** Typical genus: *Swietenia*, Mahogany (2124).
- Fam. **Euphorbiaceae:** Spurge family. Typical genera: *Euphorbia*, Spurge (2852); *Ricinus*, Castor Plant (657); *Hevea*, Para Rubber (3073); *Manihot*, Cassava (3434).
- Fam. **Oxalidaceae:** Typical genus: *Oxalis*, Oxalis (2607).
- Fam. **Rutaceae:** Typical genus: *Citrus*, Orange (2588), Lemon (1985), Lime (2011), Citron (769), Grapefruit (1499).

- Ord. **Sapindales:** Flower forms similar to Geraniales; distinguished by structure of ovules.
  - Fam. **Sapindaceae:** Soap-berry family. Contains over 1,000 species.
  - Fam. **Hippocastanaceae:** Typical genus: *Aesculus*, Buckeye (523).
  - Fam. **Celastraceae:** Typical genus: *Celastrus*, American Bittersweet (431).
  - Fam. **Anacardiaceae:** Typical genera: *Rhus*, Staghorn, Dwarf Sumach (3390); *Toxicodendron*, Poison Sumach, Poison Ivy (3390, 1854, 2852); *Manifera*, Mango (2135).
  - Fam. **Aceraceae:** Maple family. Typical genus: *Acer*, Maple (2138).
  - Fam. **Buxaceae:** Typical genus: *Buxus*, Boxwood (1628).
  - Fam. **Iliaceae:** Typical genus: *Ilex*, Holly (1673).
- Ord. **Rhamnales:** Flowers tetra-cyclic, that is the parts of the perianth arise from four distinct circles or whorls. Otherwise order resembles Sapindales.
  - Fam. **Rhamnaceae:** Buckthorn family. Typical genus: *Rhamnus*, Buckthorn (330).
  - Fam. **Vitaceae:** Shrubs and climbing vines. Typical genera: *Vitis*, Grapes (1501), Currants (940); *Ampelopsis*, Virginia Creeper (3651, 1854, 2852), Boston Ivy (1854).
- Ord. **Malvales:** Most types have carpels fused into compound pistil (syncarpous); flowers cyclic.
  - Fam. **Malvaceae:** Mallow family (906); stamens fused into tube around pistil. Typical genera: *Malva*, Mallow; *Gossipium*, Cotton (906); *Althaea*, Hollyhock (1673).
  - Fam. **Tiliaceae:** Linden family; carpels fused; stamen form indefinite. Typical genera: *Tilia*, Linden (2018); *Corchorus*, Jute (1905).
  - Fam. **Bombacaceae:** Silk cottons; seeds covered with silky hairs. Typical genus: *Adansonia*, Baobab (3532).
  - Fam. **Sterculiaceae:** Cola nut family; flowers frequently have stamens fused. Typical genus: *Theobroma*, Cacao (562).
- Ord. **Parietales:** Complex group with several lines of development; flowers usually have fused carpels; order shows marked relation to Ranales.
  - Fam. **Passifloraceae:** Typical genus: *Passiflora*, Passion Flower (2691).
  - Fam. **Begoniaceae:** Typical genus: *Begonia*, Begonia (371).
  - Fam. **Theaceae** or **Ternstroemiaceae:** The Tea family. Typical genera: *Thea*, Tea (3451); *Camellia*, Camellia (591).
  - Fam. **Violaceae:** Violet family. Typical genus: *Viola*, Violet (3644), Pansy (2664).
- Ord. **Opuntiales:** The Cactus order. Contains one family, **Cactaceae;** flowers have compound pistil. Typical genera: *Cereus*, *Opuntia*, *Echinocactus* (563).
- Ord. **Myrtales:** Flowers always cyclic; some perigynous, some epigynous.
  - Fam. **Myrtaceae:** Myrtle family. Typical genera: *Myrtus*, Myrtle (2385); *Eucalyptus*, Eucalyptus (1186); *Eugenia*, Allspice (2724); *Caryophyllus*, Clove (810).
  - Fam. **Onagraceae:** Typical genus: *Fuchsia*, Fuchsia (1381).
  - Fam. **Punicaceae:** Typical genus: *Punica*, Pomegranate (2874).
  - Fam. **Rhizophoraceae:** Typical genus: *Rhizophora*, Mangrove (2135).
- Ord. **Umbellales:** Most highly developed forms in the sub-class Archichlamydeae. Flowers always cyclic and epigynous.
  - Fam. **Araliaceae:** Typical genera: *Aralia*, False "Sarsaparilla" (3127); *Panax*, Ginseng (1460); *Hedera*, true Ivy (1854).
  - Fam. **Cornaceae:** Typical genus: *Cornus*, Dogwood (1025).
  - Fam. **Apiaceae:** The Parsley family; flowers in umbrella-shaped clusters. Typical genera: *Apium*, Celery (671); *Pastinea*, Parsnip (2691); *Daucus*, Carrot (650); *Cicuta*, Water Hemlock (2854); *Conium*, Poison Hemlock (2854).

Note: This point marks the end of the sub-class **Archichlamydeae** and the beginning of the sub-class **Sympetalae**, in which the petals are fused into tubular corolla.

- Ord. **Ericales:** Most primitive of Sympetalae.
  - Fam. **Ericaceae:** Heath family. Typical genera: *Gaultheria*, Wintergreen (3752); *Calluna*, Heather (1621); *Vaccinium*, Cranberry (915), Blueberry (439); *Azalea*, Azalea (288); *Kalmia*, Mountain Laurel (1970); *Epigaea*, Trailing Arbutus (173); *Rhododendron*, Rhododendron (3012).
- Ord. **Primulales:** Single cycle of stamens, opposite petals; seed-supporting structure "free" inside ovary.
  - Fam. **Primulaceae:** Primrose family. Typical genera: *Primula*, Primrose (2915), Cowslip (911); *Samolus*, Water Pimpernel or Brookweed; *Lysimachia*, Loosestrife or Moneywort; *Dodecatheon*, Shooting Star or American Cowslip.

- Ord. **Ebenales:** Members show both primitive polypetalous forms and advanced epigynous characteristics.
  - Fam. **Ebenaceae:** Ebony family. Typical genus: *Diospyros*, Ebony (1073), Persimmon (2740).
  - Fam. **Sapotaceae:** Sapodilla family. Typical genera: *Chrysophyllum*, Star Apple (1378); *Sapota*, Sapodilla (1378, 719); *Gutta*, Gutta-Percha Tree (1554).
- Ord. **Gentianales:** Flowers stable in type, usually with five sepals and stamens, and two carpels; corolla twisted in bud.
  - Fam. **Gentianaceae:** Gentian family. Typical genus: *Gentiana*, Gentian (1412).
  - Fam. **Oleaceae:** Olive family; leaves often leathery; many types grow flowers in clusters. Typical genera: *Olea*, Olive (2579); *Ligustrum*, California Privet (1627); *Syringa*, Lilac (2008); *Jasminum*, Jasmine (1876).
  - Fam. **Loganiaceae:** Typical genera: *Strychnos*, Nux Vomica (3372); *Gelsemium*, Yellow or Carolina Jasmine (1876).
  - Fam. **Apocynaceae:** Dogbane or Periwinkle family. Highly evolved, except that carpels are distinct. Typical genera: *Apocynum*, Dogbane; *Nerium*, Oleander (2577); *Landolphia*, African Rubber (3073); *Vinca*, Trailing Myrtle, Periwinkle (2385).
- Ord. **Polemoniales:** Flowers symmetrical with several planes of symmetry.
  - Fam. **Polemoniaceae:** Typical genus: *Phlox*, Phlox (2773).
  - Fam. **Convolvulaceae:** Twining, climbing plants. Typical genus: *Ipomaea*, Morning Glory (2327), Sweet Potato (3405, 2902).
- Ord. **Boraginales:** Types show tendency to evolve lobed ovary, resulting in four-part form.
  - Fam. **Boraginaceae:** Borage family; members usually have hairy stems. Typical genera: *Myosotis*, Forget-me-not (1331); *Heliotropium*, Heliotropes (1629).
- Ord. **Labiatales:** Flower forms tend to develop about only one axis of symmetry.
  - Fam. **Verbenaceae:** The more primitive forms. Typical genera: *Verbena*, Verbena; *Tectona*, Teak (3451).
  - Fam. **Menthaceae** or **Labiatae:** Typical genera: *Mentha*, Mint (2257); *Glecoma*, Ground-Ivy (1854); *Nepeta*, Catnip (2258).
- Ord. **Personales:** Flowers highly zygomorphic (developed about one axis of symmetry).
  - Fam. **Solanaceae:** Night shade family; members frequently poisonous. Typical genera: *Solanum*, Night Shade (2509), White Potato (2900), Egg Plant (2901), European Bittersweet (431); *Nicotiana*, Tobacco (3508, 2901); *Capsicum*, Cayenne Pepper (2901); *Atropa*, Belladonna (2509); *Mandragora*, true Mandrake (2135); *Petunia*, Petunia (2758); *Lycopersicon*, Tomato (3512, 2901).
  - Fam. **Bignoniaceae:** Trees and woody climbers; flowers often irregular. Typical genera: *Tecoma*, Trumpet Creeper (3545); *Catalpa*, Catalpa (660).
  - Fam. **Scrophulariaceae:** Figwort family; fruit two-celled; many-seeded capsule. Contains more than 2,000 species. Typical genus: *Digitalis*, Foxglove.
- Ord. **Rubiales:** Anthers usually distinct, setting order off from Campanulales; flowers epigynous.
  - Fam. **Rubiaceae:** Madder family; opposite or whorled leaves with interposed stipules. Typical genera: *Cinchona*, Quinine (2950); *Coffea*, Coffee (820); *Gardenia*, Gardenia.
  - Fam. **Caprifoliaceae:** Honeysuckle family; flat-topped flower clusters. Typical genera: *Sambucus*, Elder (1107); *Lonicera*, Honeysuckle (1678).
  - Fam. **Dipsaceae:** Typical genus: *Dipsacus*, Teazel (3489).
- Ord. **Campanulales:** Contains highest forms of Angiosperms. Anthers often converge or fuse; more than 14,500 species included in order.
  - Fam. **Campanulaceae:** Primitive stock of this last great order. Typical genus: *Campanula*, Bluebell (439).
  - Fam. **Cucurbitaceae:** The Gourd and Melon family. Typical genera: *Cucurbita*, Squash, Pumpkin (3333); *Cucumis*, Muskmelon, Cantelope (2195), Cucumber (939); *Citrullus*, Watermelon (2196); *Lagenaria*, Gourds (1492).
  - Fam. **Compositae:** Many forms here cited often grouped as family **Asteraceae,** the Aster family. The Compositae are the dominant and most highly evolved family of plants, containing over 12,500 species. Characterized by "compound" flowers (1305). Regarded as the highest type known. Typical genera: *Aster*, Aster (236); *Solidago*, Goldenrod (1483); *Chrysanthemum*, Chrysanthemum (762); *Helianthus*, Sunflower (3396); *Taraxacum*, Dandelion (957); *Arnica*, Arnica; *Lactuca*, Lettuce (823); *Cichorium*, Chickory and Endive (823); *Artemisia*, Sage (3103); *Cosmos*, Cosmos (895); *Dahlia*, Dahlia (949); *Helichrysum*, Immortelles (1740); *Carduus*, Thistle (3489); *Gnaphalium*, Cudweed (1740); *Ageratum*, Ageratum; *Rudbeckia*, Black-eyed Susan, Daisy (953); *Bellia*, English Daisy (953); *Calendula*, Marigold (2148). The Compositae are often divided into **Tubuliflorae,** which have a composite floral head made up of small tubular flowers usually surrounded by large "ray" flowers, with conspicuous petals, and **Liguliflorae** whose floral head is composed entirely of ray flowers.

ZOÖLOGY

Classification of Animals

THE members of the Animal Kingdom present a far greater variety of structure and function than the members of the Plant Kingdom. This is because the conditions of animal life are far less fixed and stable than those of plant life. Plants obtain their food directly from the air and soil; animals are for the most part compelled to move about in search of food and to adjust themselves to a far greater variety of diet. The struggle between animals for survival is more violent and active than between plants, so that the means of attack and escape are much more highly developed and versatile. Because of the greater variety of forms, animals are even more difficult to classify than plants. Countless differences of opinion exist among authorities, and the systems of classification are subject to change from year to year. The tendency, however, is always to arrive at a classification which will bring out the *natural* relationships between animals from the point of view of evolutionary theories. The method followed here is based upon the best established modern systems. It has been necessary, of course, to omit many of the minor and less important subdivisions. Consult the Botany Outline for the Key to abbreviations.

I. PROTOZOA: Primitive single celled forms, of microscopic size (2927). The following scheme is based principally on organs of locomotion.

- Cl. **Rhizopoda:** Thrust out portions of cell as "false feet." (pseudopods). Typical orders: **Lobosa,** pseudopods blunt (genus *Amoeba* 118); **Foraminifera,** coated with lime or cemented sand grains, threadlike pseudopods; **Radiolaria,** radiating spines or needles of silica or chitin-like stiffening.
- Cl. **Mycetozoa:** The Slime Molds (3251). These are often classed as plants, under the name **Myxomycetes.**
- Cl. **Sporozoa:** Parasitic upon animals. Typical order: **Haemosporidia,** blood corpuscle parasites (genus *Plasmodium,* the Malaria Parasite, 2334, 2337).
- Cl. **Mastigophora:** Have "tail" (flagellum); some zoölogists consider them the ancestors of all higher animals.
  - Ord. **Dinoflagellata:** Cellulose-armored, phosphorescent.
  - Ord. **Cystoflagellata:** Gelatinous, phosphorescent forms. Typical genus: *Noctiluca,* on ocean surface
  - Ord. **Flagellata:** One or more flagella at one end.
    - Sub-o. **Phytoflagellata:** Contain chlorophyll. Typical genera: *Volvox,* individuals cluster into visible green globules, which whirl incessantly; *Euglena,* immense numbers give green color to small pools. Group also claimed as plants by botanists, under the name **Volvocales.**
    - Sub-o. **Hemoflagellata:** Blood parasites. Typical genus: *Trypanosoma,* sleeping sickness parasite (3546, 1450 picture).
- Cl. **Ciliata:** Cuticle covered with cilia (vibrating, threadlike organs of locomotion); "dent" in cuticle functions as mouth. Typical genus: *Paramoecium,* common Slipper Animalcule. The Ciliata are sometimes grouped with various other forms in Cl. **Infusoria.**

Note: The animals from this point on are known collectively as **Metazoa,** meaning "advanced" forms as distinguished from **Protozoa,** meaning "primitive" forms. While the **Protozoa** are single-celled, the structure of the Metazoa is more complex, consisting usually of groups of cells.

II. PORIFERA: The Sponges (3328). Sac-like body of connective tissue with single opening; eat through pores in body wall. Have "skeletons," or stiffening matter, either of earthy or of felt-like material (spongin). Typical classes: **Calcarea,** skeleton of carbonate of lime; **Hexactinellida,** skeleton of silica rods (Venus's Flower Basket, Glass-Rope Sponges); **Demospongiae,** mixed types, skeleton of silica or spongin or both (Cup Sponges, Horny or Bath Sponges, Boring sponges).

III. COELENTERATA: Sac-like body; food swept into single orifice or "mouth" by fringe of tentacles; rudimentary sense organs, nerve cells, either scattered throughout body or forming connected system.

- Cl. **Hydrozoa:** Primitive types, tubular or umbrella-shaped (886). Typical orders: **Hydroida,** least developed forms (genus *Hydra* 1707); **Hydrocorallinae,** gather into coral-like colonies with limy skeletons (Millepore Coral); **Siphonophora,** attached to floating bladders or air-sacs (genus *Physalia,* Portuguese Man-of-War 1884).
- Cl. **Scyphozoa:** Body umbrella-shaped; specialized reproductive and sense organs. Typical order: **Discomedusae** (genus *Aurelia,* the common Jelly-Fish 1883).
- Cl. **Anthozoa (Actinozoa):** Individual forms (Sea Anemones 3164), and colonial forms (Corals 884). Have esophagus and primitive muscular tissue in tentacles; colonial types have stiffening matter of carbonate of lime or horny matter.
  - Sub-cl. **(Alcyonaria) Octocoralla:** Eight tentacles. Typical families: **Pennatulidae,** Sea-Pens, with feather shaped upper end (884); **Gorgoniidae,** Sea-Fans (884), Sea-Whips, and Precious Coral of Mediterranean (884, 886).
  - Sub-cl. **Zoantharia:** Forms with variable structure, excluded from **Alcyonaria.** Includes order **Actiniidae,** divisible into sub-orders **Actinaria,** Anemones, and **Madreporaria,** Madrepore Corals (885, picture).
- Cl. **Ctenophora:** Most transparent and delicate of jelly-fish; have adhesive cells instead of "nettles."

Note: The term **Vermes** was formerly used to include all the wormlike forms found in the next three groups (IV, V, and VI). But the differences between worm groups have been found to be as great as those between the other great divisions of the animal kingdom, so that most authorities no longer try to retain a single worm group.

IV. PLATYELMINTHES: Flatworms; parasitic types. Alimentary canal usually has both mouth and vent; nervous system well developed; rudimentary blood vessels and muscles.
- Cl. **Turbellaria,** aquatic, ciliated types; Cl. **Trematoda,** parasitic upon animals (genus *Distomum*, the Liver Fluke 3813); Cl. **Cestoda,** Tapeworms (3813).

V. ROTIFERA: Wheel Animalcules (3814). Microscopic; have "wheel" of cilia about free end; resemble both flatworms, primitive ringed-worms, and mollusk forms. (See Note 2, **ARTHROPODA.**)

VI. COELELMINTHES: Alimentary canal a separate tube inside tubular body.
- Cl. **Chaetognathi:** Bristles about mouth, fins on tail (genus *Saggita*, a sea-worm).
- Cl. **Nemathelminthes:** Round-Worms; muscular, sucking esophagus.
  - Ord. **Nematoda:** Thread-shaped, from microscopic length to 1 yard long. Typical genera: *Anguillula*, Vinegar Eel (3814); *Ascaris*, Round-Worm; *Oxyuris*, Pinworm; *Ankylostoma*, Hookworm (1679); *Trichina*, cause of trichinosis (3814); *Filaria*, possible cause of elephantiasis (3814).
  - Ord. **Gordiacea:** Hair Worms; typified by Horse-Hair Worm (3814).
- Cl. **Annelida:** Cylindrical; body wall segmented or "ringed"; frequently contain red blood.
  - Sub-cl. **Chaetopoda:** In most forms, each segment has bristles for locomotion. Typical orders: **Polychaeta,** marine types; **Oligochaeta,** fresh-water and soil types (Earthworm, 1066).
  - Sub-cl. **Hirudinei:** Have suckers instead of bristles; the Leeches (1984).
- Cl. **Polyzoa (Bryozoa):** Live in colonies resembling some Hydrozoans; sometimes called "Sea Moss" (3813).
- Cl. **Brachiopoda:** Lamp Shells. Have mollusk-like shells (3201, 3813, 3203 picture).

VII. ECHINODERMA: Spiny-skinned animals. Star-shaped internal structure, with alimentary canal as axis, usually with arms; skin has limy plates, usually spined; body has water tubes which when filled thrust out arms for locomotion. Heart, blood vessels, muscles, nerves, and sense organs present. Typical classes: **Asteroidea,** five arms, mouth on lower surface (genus *Asterias*, or common Starfish, 3344); **Ophiuroidea,** Brittle-Stars (3345); **Crinoidea,** Sea Lilies, mouth turned upward, arms branched and fringed, lower surface attached to bottom by stalk; **Echinoidea,** Sea Urchins, lack of arms causes globular appearance, alimentary canal coiled inside spherical body wall (Common Urchins and Sand-dollars, 3170, 3345); **Holothuroidea,** Sea Cucumbers (3165), limy plates imbedded, leaving surface leathery, travel with axis horizontal instead of vertical.

VIII. MOLLUSCA: Mollusks (2280, 3201); specialized mouth, eyes, gills or primitive lungs, digestive tract, heart and blood vessels, nervous system. Most forms have "mantle" or fold of skin, secreting shell on its outer surface.
- Cl. **Amphineura:** Primitive types. Divided into shelled type, with eight plates, enabling animal to roll into ball (Chitons 2281, 3203 picture); and wormlike forms without shells; double or "ladder-like" nerve system.
- Cl. **Pelecypoda (Lamellibranchiata):** The Bivalves (2280); mantle divided along back, have hinged shells.
  - Ord. **Filibranchia:** Gill juncture non-vascular, ciliated. Typical families: **Mytilidae,** short siphons, Mussels (783); **Pectinidae,** free-swimming, eyes on edge of mantle, Scallops (3133).
  - Ord. **Eulamellibranchia:** Gill juncture vascular. Typical families: **Ostreidae,** Oysters (2612, 2703); **Veneridae,** Quahaug Clam (783); **Myidae,** large siphons not retractable, Soft-Shelled Clam (782); **Teredinidae,** boring types, Teredo or Shipworm (3201); **Unionidae,** Freshwater Mussels (783).
- Cl. **Scaphopoda:** Tooth-Shells (3202); mantle secretes tusk shaped shell.
- Cl. **Gasteropoda:** Snail-like types (2280); conical or spiral shell; foot usually a creeping sole; primitive eyes; gills in water types, lungs in land types; heart, nerves and muscles.
  - Ord. **Prosobranchia:** Gills. Typical families: **Patellidae,** Limpets, ring-like gills; **Haliotidae,** Abalones, two comb-like gills (3203 picture); **Muricidae,** secrete purplish dye (genus *Murex* 3201); **Buccinidae,** Whelks, prey upon oysters (3256); **Cypraeidae,** Cowries, carnivorous, narrow opening in shell (3203 picture); **Ampullaridae,** Ampulla or "Watering Pot" Shell (3203 picture); **Littorinidae,** Periwinkles, top-shaped shells (2281, 3256); **Tritoniidae,** Tritons, turret-like, siphonated shells (3203, picture); **Strombidae,** foot narrow, soleless, extremely predaceous, Conches (3202), Wing Shells.
  - Ord. **Pulmonata:** Lungs, consisting of cavity with network of blood vessels. Typical families: **Helicidae,** True Snails (3255); **Limacidae,** Slugs, shell reduced (3255); **Limnaeidae,** Pond Snails.
- Cl. **Cephalopoda:** Foot bent under and joined to head; tentacles surrounding mouth; shell rudimentary ("cuttlebone") or absent. Bodily structure highly organized; well-developed eyes (941, 2280).
  - Ord. **Tetrabranchia:** Organs grouped in fours; genus *Nautilus* only living type (2418); superfamily **Ammonitoidea,** Ammonites, common among fossils.
  - Ord. **Dibranchia:** Organs grouped in twos.
    - Sub-o. **Decapoda:** Ten tentacles. Typical families: **Myopsidae,** common Squid and Cuttlefish (941, 3333); **Oigopsidae,** Giant Squid (942, 3333).
    - Sub-o. **Octopoda:** Eight-armed. Typical families: **Octopodidae,** Octopus (943, 2559); **Argonautidae,** Argonauts, female has boat-like egg case (2280).

IX. ARTHROPODA. Resemble Annelid Worms in segmentation of body, but appendages are jointed to segments; heavily armored with chitin; nervous structure resembles spinal cord; organs highly developed. The Arthropods are divided into five great classes: **(1) Crustacea,** Lobsters, Crabs, Shrimps, and Barnacles; **(2) Arachnida,** Scorpions, Spiders, and Mites; **(3) Diplopoda,** Millipedes; **(4) Chilopoda,** Centipedes; **(5) Hexapoda,** Insects.

Note 1. The **Trilobites** (1336) and the **Xiphosura** or King Crabs (913 picture) are considered by some zoölogists as relatives of the Crustacea and by others as relatives of the Arachnida.

Note 2. Many authorities are offering the theory that the Annelid Worms and the Arthropoda have both evolved from the stock of the Rotifera. Under this view, these three groups would be placed together under a new great division or phylum, called **Appendiculata,** meaning animals with "appendages" or legs.

Note 3. Because of the vast size and many subdivisions of the phylum Arthropoda, the form of the Outline has been varied in the interests of simplicity. The class names appear in the middle of the pages, while the sub-class names begin at the left-hand margin.

Class **CRUSTACEA,** Crustaceans.

Chitinous shell strengthened with lime; gills (modified for air-breathing in land types); appendages develop several branches in swimming types; have horny carapace or "shell" over combined head and thorax (**cephalothorax**).

- Sub-cl. **Entomostraca:** Segmentation variable; aquatic, primitive forms. Typical orders: **Branchiopoda,** Brine Shrimps; **Cladocera,** including Water-Fleas.
- Sub-cl. **Cirripedia:** Degenerate, parasitic types. Barnacles (331); Sacculina (2678).
- Sub-cl. **Malacostraca:** Have 20 or 21 body segments; most types have eyes on stalks.
  - Ord. **Schizopoda:** Opossum Shrimps found on American coasts and in Great Lakes.
  - Ord. **Stomatopoda:** Mantis Shrimps; have knife-like grasping claws.
  - Ord. **Decapoda** ("ten-footed"): Five segments of thorax have walking legs; have strong pincer-like grasping claws (chelae).
    - Sub-o. **Macrura:** Abdomen large and long. Typical families: **Homaridae,** Lobsters (2041); **Crangonidae,** Shrimps (3225); **Palaemonidae,** Prawns (3225); **Astacidae,** Crawfish (915); **Paguridae,** Hermit Crabs (912, 914, 913 picture).
    - Sub-o. **Brachyura:** True Crabs (912); abdomen short or rudimentary. Typical families **Cyclometopa,** Common Crabs (912 picture); **Oxyrhyncha,** including Spider Crabs (913 picture); **Catometopa,** including Fiddler Crabs, Pea Crabs (912), and Land Crabs (914 picture).

Class **ARACHNIDA,** Scorpions, Spiders, Mites.

Cephalothorax (fused head and thorax) bears six pairs of appendages, the first two used for grasping, last four pairs as legs. Mouth usually suited for sucking juices. Land forms have either lungs, or **tracheae** (tubes passing air through the body), or both.

- Sub-cl. **Arthrogastra:** Abdomen jointed. Typical orders: **Scorpionidea,** Scorpions (3145); **Phrynoidea** or **Pedipalpi,** Whip Scorpions; **Solpugida,** Wind Scorpions; **Phalangida,** Harvestmen, or "Daddy-Long-Legs"; **Pseudoscorpionida,** Book Scorpions.
- Sub-cl. **Sphaerogastra:** Abdomen non-segmented and round.
  - Ord. **Araneida:** Spiders (3320); abdomen set off from cephalothorax by deep constriction (resulting in stalk or "pedicle"); have silk glands (spinnerets). Typical families: **Theraphosidae** or **Mygalidae,** including Bird Spiders (3325 picture), American Tarantulas (3436), and Trap-Door Spiders (3324 picture); **Lycosidae,** Wolf Spiders (3324 picture); **Attidae,** Leaping Spiders; **Argiopidae** or **Epeiridae,** including common Garden Spiders (3320); **Agelenidae,** Labyrinth Spiders (3322).
  - Ord. **Acarina:** Mites. Abdomen fused with cephalothorax; mouth formed into sucking beak. Includes Red Mites, Water Mites, Ticks, "Itch" Parasites, Cheese Mites, Follicle Mites.

Note: The Centipedes and Millipedes or "Thousand-Legs" were formerly included in one class called **Myriapoda.** Centipedes, however, have been found to resemble Insects much more closely than they resemble Millipedes. For this reason the old Myriapoda class has been broken up into **Diplopoda** and **Chilopoda.**

Class **DIPLOPODA,** Millipedes.

Body cylindrical, divided into numerous segments; each two segments covered by single plate, making it appear that two pairs of legs spring from each segment (hence "Diplopoda," meaning double-footed); internal anatomy differs markedly from that of Centipedes.

Class **CHILOPODA,** Centipedes.

Centipedes (679) resemble insects except for numerous segments of body and many legs.

Class **HEXAPODA,** Insects.

The Hexapoda or Insects (1781) are distinguished from other Arthropoda by having 3 pairs of legs. Head, body, and abdomen are separate; breathe by tracheae (air tubes). The manner in which the young develop (1785-6, 1964, 2936) leads to a division of Insects into three sub-classes: **(1) Apterygota; (2) Exopterygota; (3) Endopterygota.**

- Sub-cl. **Apterygota:** New-born young closely resemble parents. Typical order: **Thysanura,** primitive, wingless forms, including Bristle Tails and Spring Tails.
- Sub-cl. **Exopterygota:** Young of most orders resemble parents; some orders show partial metamorphosis.
  - Ord. **Ephemerida** or **Ephemeroptera:** Consists of a single family **Ephemeridae,** May-Flies (2178).
  - Ord. **Odonata:** Dragon Flies and Damsel Flies (1028); strong biting jaws; larvae aquatic.
  - Ord. **Plectoptera:** Stone Flies; larvae aquatic, with gills.
  - Ord. **Isoptera:** Social habits similar to ants, but bodily structure differs. Includes White Ants or Termites (143, 1788).
  - Ord. **Corrodentia:** Winged; single family **Psocidae,** Book Lice.
  - Ord. **Mallophaga:** Bird Lice; wingless; biting mouths.
  - Ord. **Euplexoptera:** Front wings hardened into covers; tip of abdomen bears pincers. Typical family: **Forficulidae,** Earwigs (1784).
  - Ord. **Orthoptera:** Straight-winged, the front pair stiffened into covers; mouth adapted for biting and chewing. Includes three sub-orders **(1) Cursoria** or "Runners" such as Cockroaches (817); **(2) Gressoria** or "Walkers" such as Mantis (2137), Stick Insects and Leaf Insects (1785 pictures); **(3) Saltatoria** or "Jumpers" such as Grasshoppers and Locusts (1503), Katydids (1913), and Crickets (921).
  - Ord. **Physopoda** or **Thysanoptera:** Thrips; small forms; sucking mouth.
  - Ord. **Hemiptera:** True Bugs; mouth parts developed for piercing and sucking. Divided into three sub-orders: **(1) Heteroptera,** such as Water Bugs (3696), Bed Bugs, and Chinch Bugs (752); **(2) Homop-**

tera, such as Cicadas (764), Aphids (154), Scale Insects (3132), and Cochineal (817); and **(3) Anoplura,** such as Body Lice (2679 picture).

Sub-cl. **Endopterygota:** Young undergo complete larva-pupa metamorphosis.

- Ord. **Neuroptera:** Membranous, net-veined wings; usually carnivorous upon other insects. Includes Ant-Lions (152) and Lacewing Flies (1789).
- Ord. **Mecoptera:** Single family **Panorpidae,** Scorpion Flies.
- Ord. **Trichoptera:** Larvae aquatic, with gills; build shelters of sticks or stones. Includes Caddis Flies (1786 picture).
- Ord. **Lepidoptera:** Butterflies and Moths (544); scales on wings; larvae usually called "Caterpillars" (660). Typical families: **Tortricidae,** including Codlin Moths (820); **Geometridae,** Cankerworms (630); **Bombycidae,** including Silk Worms (3240); **Noctuidae,** including Army-Worms (218) and Cutworms (944); **Pieridae,** including Cabbage Butterfly and Clouded Yellow Butterfly; **Papilionidae,** including Swallow Tails; **Nymphalidae,** the dominant butterfly family, including Admirals, Emperors, Tortoise Shells, etc.
- Ord. **Diptera:** True Flies (1313); two-winged, except when wings have degenerated; sucking mouth. Divided into four sub-orders: **(1) Nemocera,** body and proboscis long, including Mosquitoes (2334), and Hessian Flies (1645); **(2) Tanystoma,** body short and proboscis long, including Black Flies and Horse-Flies (1313); **(3) Brachycera,** body short and thick, including House Flies (1312), Blow Flies, Robber Flies, Flesh Flies, and Bot Flies (1313), Tsetse Flies (3546), Hover-Flies (1791 picture); and **(4) Pupipara,** parasites, often wingless, includes Sheep Tick, Bee Louse (1313, 2679 picture).
- Ord. **Siphonaptera:** Fleas (1292); wingless; sucking tubes.
- Ord. **Coleoptera:** Beetles (366), sheath-winged, like Orthoptera; biting mouths; includes over 100,000 known species. The chief beetle families are listed on page 371. See also Weevils (3713), June Bug (1902), Potato Bug (2902), Lady-Bug (1955), and Fireflies and Glowworms (1262).
- Ord. **Hymenoptera:** Four membranous wings; higher forms have elaborately developed instincts; tip of abdomen often equipped with sting. Divided into two sub-orders:
    - Sub-o. **Symphyla:** Sawflies, primitive types with no waist constriction.
    - Sub-o. **Apocrita:** With constricted waists and other higher features. The Apocrita are divided into seven super-families:
        1. **Cynipoidea:** Gall Flies. Most members lay eggs in plant tissue, producing swelling or "gall" (2548).
        2. **Chalcidoidea:** Usually have bright metallic colors; includes Fig Wasps (1237).
        3. **Ichneumonoidea:** Ichneumon Flies (1724); long, curved ovipositors, for laying eggs in larvae of other insects.
        4. **Vespoidea:** Wasps (3690). Typical Families: **Vespidae,** social types, including Hornets and Yellow Jackets; **Eumenidae,** solitary types, including Potter Wasps; **Pompilidae,** solitary Spider Wasps; **Masaridae,** solitary types usually dwelling in mud banks.
        5. **Sphecoidea:** Mud-Dauber Wasps; solitary types, including Fly-Hunters (3692) and "Tool-Using" Wasps (3692).
        6. **Apoidea:** Bees (359); honey feeders. Typical families: **Apidae,** Hive Bees (359, 364), tongue short, social life highly organized; **Bombidae,** Bumble Bees (362, 364), tongue long, make "honey-pots" instead of combs; **Megachilidae,** solitary types such as Mason, Leaf-Cutter, and Potter Bees; **Ceratinidae,** small solitary Carpenter Bees; **Xylocopidae,** large Carpenter Bees; **Andrenidae,** Burrowing Bees.
        7. **Formicoidea:** Ants (139); females differentiated into queens and workers; social life highly organized. The social ants are grouped into a single great family, **Formicidae.** Certain so-called "Solitary Ants," **Mutillidae,** are sometimes ranked with the super-family Formicoidea.

X. CHORDATA: Body-wall cylindrical, usually with appendages (fins, wings, limbs, etc.). Body stiffened in primitive forms by gristly rod called a *notochord,* lying along spinal cord (128); in higher forms notochord develops vertebrae, many of them supporting ribs.

- Sub-ph. **LEPTOCARDII:** Body pointed at both ends; lacks all appendages except tail fin; internal structure extremely primitive; animals lie buried in sand. Typical of this group is the genus *Amphioxus,* Lancelets (1271, 128 diagram).
- Sub-ph. **TUNICATA:** Sea-Squirts; usually have mollusk-like mantle or tunic containing cellulose; rudimentary heart.
- Sub-ph. **ENTEROPNEUSTA:** Worm-like body; short spinal column, connected by nerve-collar to another system along abdomen. Typical genus, *Balanoglossus.*
- Sub-ph. **VERTEBRATA:** The Vertebrates (3634). Notochord found in embryo of all Vertebrates, and remains in the modified form of cartilage skeleton among the lower fishes; higher types develop true bony skeletons. The Vertebrates are divided into five classes: **Pisces,** Fishes; **Amphibia** or **Batrachia,** Amphibians; **Reptilia,** Reptiles; **Aves,** Birds; **Mammalia,** Mammals.

Note: The sub-phylum **Vertebrata** includes all the remaining members of the Animal Kingdom. Scientists believe that the first Vertebrates were primitive Fishes; that certain of these Fishes gave rise to the Amphibians; that certain of the Amphibians gave rise to the primitive Reptiles; and that from these in turn were evolved the modern Reptiles, Birds, and Mammals. The same arrangement will be followed as in the case of the Arthropods, the Class names occupying the middle of the page and the Sub-Class names beginning at the left-hand margin.

Class **PISCES**, Fishes.

All Fishes (1271) are water dwellers; breathe with gills; skeleton structure varies from primitive notochord forms to highly organized bony forms.

Sub-cl. **Cyclostomata** (**Marsipobranchii**): Sucker mouth instead of jaws; primitive skull; spine consists of chord and notochord rod. Includes Lampreys and Hag fishes (1958, 1271, 1272 picture).

Sub-cl. **Elasmobranchii:** Snout overhangs mouth; true jaws; skeleton cartilaginous; skin smooth with limy dots. Typical orders: **Selachii,** Sharks (3196); **Batoidei,** including Skates and Rays (3244, 1272 picture), Torpedo-Fish (3517), Sawfish (3131).

Sub-cl. **Teleostomi:** Fishes with well-developed jaws and skulls; body skeleton varies from partly cartilaginous to well-developed bony type.

- Ord. **Crossopterygii:** Fins have bony axis, fringed with spines or rays. Numerous fossil types; two living African genera. The **Crossopterygii** or "Fringe-Finned Ganoids," as they are sometimes called are important because they are believed to have been the ancestral stock of all the higher Vertebrates.
- Ord. **Dipneusti** (**Dipnoi**): Lung-fishes (2363); gristly skeleton; swim bladder has unusually rich lining of blood-vessels and serves as primitive lung when fish are out of water. Numerous in Paleozoic times; few living types.
- Ord. **Ganoidei:** The Ganoids (1272, 1277, 3374). Skeletons vary between primitive (cartilaginous) and advanced (bony) types; skin covered with bony plates, almost scale-like in some types. Typical sub-orders: **Chondrostei,** including Sturgeons (3374); **Holostei,** including Garpike and Bowfins (2365).
- Ord. **Teleostei:** The Bony Fishes; well-developed skeletons; skin usually has well-developed scales. Divided into the following typical sub-orders.
    1. **Malacopterygii:** Fin-rays soft. Includes Herring (1645), Shad (3188), Sardines (3126), Tarpon (3438), Salmon (3113), Trout (3545), Whitefish (3733, 1286), Cisco or Lake Herring (3733).
    2. **Ostariophysi:** Swim bladder sensitive to external pressure through chain of small bones called "Weberian ossicles." Includes Electric Eel (3517), Carp (1278), Chubs, Suckers, and Buffalo Fish (1283), Goldfish (1483), Catfish (662).
    3. **Apodes:** Eel-like forms. Includes Common Eels (1089), Pelican Fish (1273 picture).
    4. **Haplomi:** Differ from Malacopterygii in details of skeleton. Includes Pike (1278), Pickerel (1278), Muskellonge (1278).
    5. **Thoracostei:** Specialized gill structures. Includes Sticklebacks (3357), Sea Horses (3165).
    6. **Percesoces:** Swim bladder ductless; lower jaw bones fused into single piece. Includes Flying Fish (1314), Climbing Perch (1277, 1273 picture).
    7. **Anacanthini:** Soft-finned, but otherwise resembling spiny-finned fishes. Includes Cod and Haddock (1278).
    8. **Acanthopterygii:** Bony spines in fins. Includes Mackerel (2102), Tunny, Albacore and Bonita (3552), Pompano, Redfish, and Tilefish (1279), Angler Fish (1273 picture), Gurnards (1273 picture), Lumpsucker (1275 picture), Perch (2726), Angel or Coral Fishes (1271 picture), Bass (1278), fresh-water Sunfish (3396), Swordfish (3423), Flatfish (1289, 1301).
    9. **Plectognathi:** Highly specialized forms, with jaw bones fused into single pieces. Includes marine Sunfishes (3396).

Class **AMPHIBIA** or **BATRACHIA,** Amphibians.

The Amphibians mark an intermediate stage between Fishes and Reptiles. As their name indicates (*amphi*, on both sides, *bios*, life), they are fitted for life in water and on land. The typical Amphibians undergo metamorphosis, that is they hatch from the eggs as gill-breathing *larvae* (tadpoles, for example), which then develop into lung-breathing adults. There are, however, exceptions to this rule. The fins of the Fishes are in the Amphibians replaced by legs; the skin is soft and glandular; heart is three-chambered. In former geologic periods, Amphibians were abundant, but today there are comparatively few species, mostly divided into the following two orders.

- Ord. **Caudata** or **Urodela:** Tailed forms; types able to regenerate lost parts. Includes Salamanders and Newts (3112).
- Ord. **Ecaudata** or **Anura:** Tailless forms. Typical sub-orders: **Aglossa,** tongue degenerate, such as Pipa Toad; **Phaneroglossa,** tongue developed, including True Toads (3506) and Frogs (1373).

Class **REPTILIA,** Reptiles.

The Reptiles (2997) have no larval stage; skeleton specialized for land life; four-chambered heart; aquatic forms breathe at surface; skin covered with scales or bony plates. The most primitive Reptile stock is supposed to have evolved two great branches. The first, springing from Theromorphodont stock (see sub-class Theromorpha below) gave rise to the first Mammals and various specialized Reptiles, of which the Turtles are highest. The second branch came from stock of which the Tuatura or Sphenodon is a living example, and gave rise to the first Birds and specialized Reptiles, of which the Crocodiles, Snakes, and Lizards are the living forms. These two great groups are marked "Evolutionary Group A" and "Evolutionary Group B."

Evolutionary Group A.

Sub-cl. **Theromorpha:** Varied extinct forms, with many skeletal details and teeth transitional between Amphibia and Mammals.

Sub-cl. **Plesiosauria:** Plesiosaurs (2997). Extinct forms; long necks, paddle limbs; comparatively slow-moving, aquatic types.

Sub-cl. **Ichthyosauria:** Ichthyosaurs (2997). Extinct forms; short necks, toothed beaks; swift-moving, whale-like forms, exclusively aquatic; bore living young.

- Sub-cl. **Chelonia:**
  - Ord. **Chelonia:** Turtles (3562). Toothless, horny beak; body protected by bony case; limbs developed for walking or swimming. Divided into two sub-orders: **(1) Athecae,** shell leathery, including Leatherbacks (3562); **(2) Thecophora,** shell hard, including Land Tortoises (3520), and all the remaining Turtles (3562-3).

Evolutionary Group B.

- Sub-cl. **Prosauria:** Typical sub-order is Rhynchocephalia, of which the Tuatara or Sphenodon (2038) is the only living representative. First birds may have developed from Prosaurian stock.
- Sub-cl. **Pterosauria:** Extinct flying reptiles, in outward appearance like bats. Typical order: **Pterodactyli,** the Pterodactyls (134, 136).
- Sub-cl. **Dinosauria:** Extinct; represented by many Mesozoic monsters (132). Some had many bird-like features (hollow bones, anatomy of hind leg, etc.), but birds already existed when these forms flourished.
- Sub-cl. **Crocodilia:**
  - Ord. **Crocodilia:** Differ from other reptiles chiefly in skull structure. Order includes Crocodiles (922), and Alligators (98).
- Sub-cl. **Sauria:** Lizards and Snakes. Differ from other reptiles chiefly in structure of skeleton.
  - Ord. **Ophidia:** Snakes (3257). Lack limbs; halves of lower jaw connected by elastic tissue. See also articles on Boa Constrictor (440), Pythons (2942), Cobra (816), Vipers (3646), Rattlesnake (2978), Moccasin (2274), and Copperhead (884).
  - Ord. **Lacertilia:** Lizards (2035); limbs usually developed and functional; halves of lower jaw fused solidly together. Divided into three sub-orders: **(1) Lacertae,** most typical Lizards, including Garden Lizards, Iguanas (1729), Horned Toads (2037–8), Gila Monsters (2035, 2037), Swifts (2038), Glass Snakes (2037, 2036 picture); **(2) Geckones,** the Geckos (2037, 2038 picture); **(3) Chameleontes,** the True Chameleons (685).

Class AVES, Birds.

The skeleton of Birds (400–426) resembles the reptile type, save in modifications to permit flying; skin produces feathers (1228); four-chambered heart; teeth lacking except in fossil forms. The primitive ancestor of all Birds probably came from reptile stock.

- Sub-cl. **Archeornithes:** Extinct forms; possessed teeth. Includes, Archaeopteryx (401 picture).
- Sub-cl. **Ratitae:** Running types; lack "keel-shaped" (carinate) breastbone; orders differ in bones of foot (2603).
  - Ord. **Struthiones:** Two-toed. Includes True Ostriches (2603).
  - Ord. **Rheae:** Three-toed; feathers have short aftershafts. Includes Rhea (2603).
  - Ord. **Casuarii:** Three-toed, feather aftershafts as long as main shafts, giving shaggy appearance to plumage. Includes Cassowaries (654), Emus (1145), and extinct Moas (3443 picture).
  - Ord. **Apteryges:** Four toes, bill long and slender. Includes Apteryx or Kiwi (409 picture of foot).
- Sub-cl. **Carinatae:** Contains all types which have "keel-shaped" (carinate) breastbones.
  - Ord. **Pygopodes:** Diving birds, webbed feet set far back toward tail. Order includes Loons (2062), Grebes (413 picture), Auks (258), Puffins, and Murres.
  - Ord. **Impennes:** Wings developed into swimming paddles. Includes Penguins (2715).
  - Ord. **Longipennes:** Long-winged sea-birds. Includes Gulls and Terns (1549, 413 picture).
  - Ord. **Tubinares:** Sea-birds with tubular nostrils. Includes Petrels (2747), Albatrosses (80).
  - Ord. **Steganopodes:** Yoke-toed water birds; good fliers. Includes Pelicans (2709), Frigate Birds (1372), Cormorants (413, 751 picture), and Gannets.
  - Ord. **Anseres:** Bills in most types have fluted "strainers" along edge (1044 picture); front toes webbed. Includes Ducks (1044), Geese (1487), Swans (3399), Mergansers (1046).
  - Ord. **Odontoglossae:** Intermediate between Anseres and Herodiones; characterized by box-like beak. Flamingoes (1289, 414 picture).
  - Ord. **Herodiones:** Long-legged wading birds; divided according to beaks into three sub-orders: **(1) Herodii,** bill straight, sharp-pointed, including Herons (3364, 414 picture), Bitterns (431), and Egrets (3365); **(2) Ibides,** bill grooved on each side, including Ibis (3364), Spoonbills (3364); **(3) Ciconiae,** bill thick at base, curved at tip including Common Stork and American Wood Ibis (3362, 3365).
  - Ord. **Paludicolae:** Marsh dwellers; hind toe higher on leg than others; fly with neck extended. Includes Cranes (3365, 915), Rails and Coots (2961).
  - Ord. **Limicolae:** Shore Birds; long, thin legs; feet usually unwebbed; wings V-shaped when open; good fliers. Includes Plovers (2838), Killdeers, Avocets, and Stilts (2839), Snipe, Sandpipers, and Curlews (3261), Woodcock (3779).
  - Ord. **Gallinae:** Fowl-like birds; bill, wings, and legs short, hind toe elevated; body heavy. Includes Quail, Bobwhites, and Partridge (2943), Grouse (1543), Prairie Chickens and Ptarmigans (1545), Turkeys (3556), Pheasants (2759), Peacocks (2699), Domestic Fowl (2908).
  - Ord. **Columbae:** Bills swelled at base; hind toes level with front toes. Includes Pigeons and Doves (2803).
  - Ord. **Raptores (Accipitres):** Group is set off by habits rather than physical characteristics; bills strongly hooked. Includes three sub-orders: **(1) Sarcorhamphi,** Buzzards (550), Condors (856), Vultures (3662); **(2) Falcones,** including Hawks and Falcons (1605), Eagles (1053), Kites (1930), Secretary Birds (3171); **(3) Striges,** Owls (2606).
  - Ord. **Psittaci:** Parrots, Macaws, and Cockatoos (2690, 2094); short hooked bill; two toes point forward and two back.

Ord. **Coccyges:** (417). Includes Cuckoos and Road-Runners (939), Kingfishers (1925), Turacos (411), Hornbills (1681).

Ord. **Pici:** Feet and tail suited for clinging to bark; long barbed tongue. Includes Woodpeckers (3780, 416 picture), Flickers (3780, 416 picture), Sapsuckers (3781, 416 picture), Toucans (3520).

Ord. **Macrochires:** Long-winged land types; feet weak, unsuited for perching. Includes Goatsuckers or Nighthawks (2508), Whippoorwills (3732), Humming Birds (1698, 416 picture), Swifts (3398, 3399, 416 picture).

Ord. **Passeres:** The "perching" birds; feet suited to grasping branches or twigs. This is by far the largest of the bird orders. The leading families of this order, including all the families found in North America, are listed in the table on page 412. See also Flycatchers (1313), Kingbirds (1925), True Larks (1963), Crows (926), Jackdaws and Rooks (2124), Blue Jays (440), Starlings (3345, 417 picture), Orioles (2600, 417 picture), Bobolinks (446, 418 picture), Blackbirds (432, 417 picture), Meadowlarks (2179, 418 picture), Finches (1241), Grosbeaks (1542, 418 picture), Sparrows (3308, 418 pictures), Cardinals (642), Tanagers (3432, 420 picture), Swallows and Martins (3398, 419 picture), Waxwings (3706), Shrikes (3225, 419 picture), Vireos (3647, 419 picture), Warblers (3669, 420 picture), Titlarks, Wagtails, and Pipits (3505, 419 picture), Mocking-birds (2274, 419 picture), Thrashers (3492), Catbirds (660), Wrens (3815, 419 picture), Nuthatches (2544, 420 picture), Creepers (2544, 419 picture), Titmice (3505), Chickadees (728, 420 picture), Nightingales (2508), Kinglets and Gnatcatchers (1926, 420 picture), Thrushes (3494), Robins (3028, 420 picture), Bluebirds (439).

Class **MAMMALIA,** Mammals.

The Mammals (2132) include all vertebrates which have true hair and the young of which are nourished with their mothers' milk. The class is here subdivided into three sub-classes according to the degree of development of the young at the time of birth. It is generally believed by scientists that mammals evolved from reptile stock, although the course of evolution thereafter is uncertain. The earliest known Mammals lived at about the same geologic period as the giant Reptiles and the first Birds.

Sub-cl. **Prototheria:** Primitive types; lay eggs and hatch young; one living order, **Monotremata.** Includes Duckbill (1046) and Spiny Ant-Eaters (266 picture).

Sub-cl. **Metatheria:** Young born alive but not perfectly formed; development completed in a skin-pouch on mother's body. One living order, **Marsupialia,** divided into two sub-orders: **(1) Diprotodonta,** teeth adapted to vegetable food, including Wombats (1908, 266, 397 picture), Phalangers (1908, 266 picture), Kangaroos (1907, 266); **(2) Polyprotodonta,** teeth adapted to animal food, including Opossums (2585), Tasmanian Devil and Tasmanian Wolf (3438, 3439), Bandicoots (266).

Sub-cl. **Eutheria (Placentalia):** Young completely developed when born (1908); often divided into four groups according to presence of claws, hoofs, flippers, or nails on the extremities. The flippered Sirenians (See Ord. Sirenia) are classed, however, with the hoofed group, since their internal structure is that of a hoofed animal. The seals are placed in the clawed group for a similar reason.

Group A. **Unguiculata** (Clawed Animals).

- Ord. **Insectivora:** The most primitive of the higher Mammals; teeth suited for eating insects; feet plantigrade (heel-walking); most types nocturnal. Typical sub-orders: **(1) Menotyphla,** pelvis united, including Tree Shrews with bony-ringed eye socket, and Elephant or Jumping Shrews with imperfect eye socket and hind legs elongated; **(2) Lipotyphla,** pelvic union imperfect, including Moles (2278), Shrews (2279), Hedgehogs (1627).
- Ord. **Dermoptera:** Flying Lemurs; curious Malayan forms, with affinities to Insectivora, Bats, and Lemurs. Only two species are known.
- Ord. **Chiroptera:** Bats (345); fore-limbs winged; internal structure modified for true flight. Typical sub-orders: **(1) Megachiroptera,** teeth adapted to fruit-eating, Flying Foxes (346); **(2) Microchiroptera,** adapted to eating insects or sucking blood, including Vampires (346), and Common Bats (345).
- Ord. **Carnivora:** Flesh-Eaters. A mixed group, containing types which sometimes eat vegetable food as well as the true flesh-eaters. Teeth and skeleton structure adapted to seizing and killing prey. Divided into two sub-orders, according to habitat.
  - Sub-o. **Fissipedia:** Terrestrial types.
    - Fam. **Canidae:** Dogs (1018); Wolves and Coyotes (3774); Jackals (1855); Foxes (1336). Structure adapted for running down prey; feet digitigrade or "toe-walking."
    - Fam. **Procyonidae:** Raccoons (2951); usually tree-dwellers; feet plantigrade.
    - Fam. **Ursidae:** Bears (349); teeth adapted alike to vegetable and flesh diet.
    - Fam. **Mustelidae:** Weasel family. Body long, slender, active; teeth highly evolved; feet partly digitigrade. Includes Martens and Sables (2155), Stoats or Ermine (1174), Weasels (3707), Polecats (3246), Ferrets (1234), Minks (2251), Gluttons or Wolverines (3776), Skunks (3246), Badgers (303), Otters (2605).
    - Fam. **Hyaenidae:** Hyenas (1711). Many dog-like characteristics.
    - Fam. **Viverridae:** Mongooses (2286), Civets (2728), Aardwolves. Types intermediate between hyenas and cats, with more teeth than cats.
    - Fam. **Felidae:** Cat family. Most highly specialized carnivores; structure suited for leaping upon prey. Includes Cats (657), Jaguars (1859), Leopards or Panthers (1988), Lions (2024), Ocelots (1989), Pumas or Mountain Lions (2933), Tigers (3498), Lynxes (2087), Cheetahs (1989).

Sub-o. **Pinnipedia:** Aquatic forms, limbs partially or wholly developed into flippers. Includes True Seals (3166–7), Walruses (3668), Sea-Bears or Fur-Seals (3166, 3167–8), Sea-Lions and Sea-Elephants (3168).

Ord. **Rodentia:** Rodents (3036); teeth and jaws adapted to gnawing.

Sub-o. **Simplicidentata:** Single pair of incisors in upper jaw; families differ in skull structure and dentition. Includes Squirrels (3333), Chipmunks (752), Prairie Dogs (2912), Marmots (2912, 1543), Groundhogs or Woodchucks (1543), Beavers (356), Pouched Rats or Pocket-Gophers (1488), Kangaroo Rats (2977), Dormice (1027), Jerboas (2977), Hamsters (2977), Voles or Field Mice and Lemmings (2359), Muskrats (2384), True Rats (2977) and Mice (2359), Porcupines (2883), Cavies or Guinea-Pigs (1548), Capybaras (3036), Chinchillas (752).

Sub-o. **Duplicidentata:** Two pairs of incisors in upper jaw, one behind the other. Includes Picas or Mouse Hares (1585), Hares and Rabbits (1583).

Ord. **Edentata:** Toothless or with rudimentary teeth in rear of jaw; exceedingly varied types. Two sub-orders: **(1) Pilosa,** hairy types, including Ant-Eaters (145); **(2) Dasypoda,** armoured types, including Armadilloes (211).

Ord. **Pholidota:** True Scaly Ant-Eaters or Pangolins. Covered with horny, overlapping scales.

Ord. **Tubulidentata:** Aardvarks (145). Tubular snout, large number of lumbar vertebrae.

Group B. **Ungulata** (Hoofed Animals).

Ord. **Artiodactyla:** Hoofed animals, usually even-toed; odd-toed types have digits symmetrical about the vertical mid-plane of the hoof.

Sub-o. **Suina:** Lower leg not fused into cannon bone; upper incisor teeth always present, often tusked. Stomach varies from simple to ruminant type.

Fam. **Suidae:** Pigs (1670); Wild Boars (440). Snout has fleshy button; tusks of male curve upward; stomach simple; four toes on each foot, outside two not touching ground.

Fam. **Tagassuidae:** Peccaries (2706, 1671 picture). Tusks small, point downward; front feet have four toes (two not touching ground) and rear feet only three.

Fam. **Hippopotamidae:** Hippopotamus (1651–3). Muzzle broad, rounded; stomach complex; all four toes touch ground.

Sub-o. **Tylopoda:** Feet have large, cushioned pads; stomach complex but not completely ruminant (3083). Typical family: **Camelidae,** including Camels (588), Alpacas and Vicunas (100), Llamas (2039).

Sub-o. **Pecora:** The true ruminants (3082) or "cud-chewers."

Fam. **Giraffidae:** Giraffes (1463). Adapted to browsing; solid horned.

Fam. **Cervidae:** Deer (979). Antlers solid-horned, shed annually. See also Caribou (644), True Elk or Moose (2325, 1138), Musk Deer (2383), Reindeer (2993), American "Elk" or Wapiti (3669, 1138).

Fam. **Antilocapridae:** American Antelope or Pronghorns (146, 147 picture). Have hollow horns growing from bony cores and shedding annually.

Fam. **Antelopidae:** True Antelopes (146), Chamois (686), Rocky Mountain Goat (146, 147 picture). Permanent hollow horns growing from bony horn-core.

Fam. **Bovidae:** Short cannon bones; permanent hollow horns from bony horn-core. Includes Common Cattle (662), True Buffalo (527), Zebus (3838), Yaks (3827), Goats (1476), Ibex (1719), Bison or American Buffalo (428), Aurochs (431), Musk oxen (2383).

Ord. **Perissodactyla:** Usually odd-toed; where toes are even in number, they are not symmetrical about the vertical mid-plane of the hoof.

Fam. **Equidae:** Foot structure highly evolved (1682), teeth unusually long. Includes Horses (1683), Asses (235), Zebras (3838).

Fam. **Tapiridae:** Tapirs (3434); have proboscis, small tusks and simple teeth; front foot has four toes.

Fam. **Rhinocerotidae:** Rhinoceroses (3006–7).

Ord. **Proboscidea:** Nose and upper lip extended to form trunk. Includes Elephants (1126–32), Mammoths (2132, 667 picture), Mastodons (2132).

Ord. **Sirenia:** Aquatic mammals with flippers; eat vegetable food, in contrast with Cetaceans (see Group C. Cetacea) and the Seals (See Ord. Carnivora); internal structure indicates descent from ancestor of Proboscideans. Includes Manatees (2134), and Dugongs (2134).

Ord. **Hyracoidea:** Curious types, with some features of skull unique among mammals, cheek teeth like those of rhinoceros; in size and habits like hares. Includes Hyraxes or Rock-Rabbits, called "Conies" in the Bible.

Group C. **Cetacea** (Mammals with True Flippers).

Ord. **Odontoceti:** Toothed Whales (3726). Order includes Sperm-Whales (3726), Dolphins (1026–7), Porpoises (2884), Grampuses (3723), and Narwhals (2884, 3723).

Ord. **Mystacoceti:** Whalebone Whales. Order includes Right Whales (3724), Rorquals (3726, 3725 picture), Humpbacks (3725 picture).

Group D. **Primates** (Mammals with Nails).

Ord. **Primates:** Five-fingered hands and five-toed feet, with nails; eyes directed forward.

Sub-o. **Lemuroidea:** Lemurs (1986). Face long and fox-like; long tails, not suited for grasping.

Sub-o. **Anthropoidea:** Face rounded, cranium comparatively high; details of internal organs closer to human type than those of Lemurs. The Anthropoidea are divisible into two sections: **(1) Platyrrhina** or New World types (2289), with nostrils far apart, tail often prehensile, three pairs of premolar teeth in each jaw; **(2) Catarrhina** or Old World types, with nostrils close together, tail never prehensile, two pairs of premolar teeth in each jaw. The first two families are New World types, the remainder belong to the Old World section.

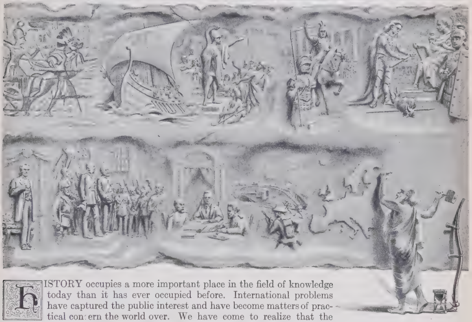
- Fam. **Cebidae:** New World Monkeys (2289) with opposable thumbs, more or less naked ears, and flat or curved nails.
- Fam. **Hapalidae:** Marmosets (2290, 2289 picture). Hairy ears; thumb not opposable, nails clawlike.
- Fam. **Hylobatidae:** Gibbons (2288 picture), long-armed, tailless; thumb short, backbone without S-shaped curve of higher types.
- Fam. **Cercopithecidae:** Old World Monkeys (2289) including Baboons (2292). Wedge-shaped chest; arms shorter than legs; tail usually present.
- Fam. **Simiidae:** Higher Apes (153). Broad chest; arms longer than legs, but shorter than in Gibbons; S-shaped curve of backbone partially developed; prominent canine teeth; jaws not curved at sides as in man; cerebrum smaller than in man. Includes Orang-utans (2590), Chimpanzees (738), Gorillas (1491).
- Fam. **Hominidae:** The human type. Single living genus, with one living species—**Homo sapiens,** or Man (2133).

Books for the Biology Student

Note: The list of books which accompanies the Outline on Nature Study deals with the habits of plants and animals from the point of view of common experience and observation. The books listed here emphasize rather the fundamental laws of life, the structure and physiology of living creatures, and the history of life and its evolution. They were chosen for their importance, their clearness, and their interest, and while they may present a few technical difficulties to the newcomer in Biology, they will soon prove as fascinating as any story of travel or adventure.

Biology for Beginners. Truman J. Moon.
Elementary Biology. Benjamin C. Gruenberg.
Biology: An Introductory Study. Herbert W. Conn.
Biology and Its Makers. W. A. Locy.
A History of Science. H. S. and E. H. Williams.
The Science of Life. J. Arthur Thomson.
Applied Biology. Maurice A. and Mrs. Anna N. Bigelow.
A Source Book of Biological Nature Study. Elliot Rowland Downing.
Dynamics of Living Matter. Jacques Loeb.
The Organism as a Whole. Jacques Loeb.
The Cell in Development and Inheritance. Edmund B. Wilson.
Principles of Nutrition. W. H. Jordan.
Elementary Studies in Botany. J. M. Coulter.
Practical Botany. Joseph Y. Bergen and Otis W. Caldwell.
Laboratory and Field Manual of Botany. Joseph Y. Bergen and Bradley M. Davis.
Handbook of Practical Botany. Eduard Strasburger.
Botany for High Schools and Colleges. Charles E. Bessey.
Nature and Development of Plants. Carlton C. Curtis.
Experiments with Plants. W. J. V. Osterhout.
Plant Life and Plant Uses. John Gaylord Coulter.
Plants and Their Uses. Frederick L. Sargent.
Plant Anatomy. William Chase Stevens.
An Introduction to Vegetable Physiology. J. Reynolds Green.
Lectures on Plant Physiology. Ludwig Jost.
Plant Relations. J. M. Coulter.
Plant Structures. J. M. Coulter.
The Living Plant. William F. Ganong.
Natural History of Plants (4 vols.). Anton Joseph Kerner.
Plant Geography upon a Physiological Basis. A. F. W. Schimper.
Scientific Aspects of Luther Burbank's Work. Vernon L. Kellogg and David Starr Jordan.
Plant Breeding. Hugo de Vries.
New Creations in Plant Life. William S. Harwood.
Fundamentals of Plant Breeding. J. M. Coulter.
Fertilization of Flowers. Hermann Müller.
Bacteria, Yeasts, and Molds in the Home. Herbert W. Conn.
Mosses with a Hand Lens and Microscope. A. J. Grout.
The Ferns of North America. Daniel Cady Eaton.
Our Native Ferns and How to Study Them. Lucien M. Underwood.
Flower Guide. Chester A. Reed.
Field Book of American Wild Flowers. Ferdinand Schuyler Mathews.
Trees of the Northern United States. Austin C. Apgar.
Familiar Trees. Ferdinand Schuyler Mathews.
Manual of the Trees of North America. Charles S. Sargent.
The Elements of Animal Biology. Samuel J. Holmes.
An Introduction to Zoölogy. Robert W. Hegner.
Manual of Zoölogy. Thomas J. Parker and William A. Haswell.
Zoölogy, Descriptive and Practical. Buel P. Colton.
A Textbook of Zoölogy (2 Vols.). Thomas J. Parker and William A. Haswell.
Economic Zoölogy. Herbert Osborn.
Animals of the Past. Frederic A. Lucas.
The Animals and Man. Vernon L. Kellogg.
Animal Intelligence. George J. Romanes.
Animal Behavior. C. Lloyd Morgan.
The Geographical Distribution of Animals. Alfred Russel Wallace.
The Insect Book. L. O. Howard.
The Spider Book. J. H. Comstock.
Genera of Fishes. David Starr Jordan.
The Reptile Book. Raymond L. Ditmars.
Bird Life. Frank M. Chapman.
A Geographical History of Mammals. Richard Lydekker.
Mammals Living and Extinct. W. H. Flower and Richard Lydekker.
The Age of Mammals. Henry Fairfield Osborn.
A History of Land Mammals in the Western Hemisphere. William Berryman Scott.
The Origin of Species. Charles Darwin.
Mendel's Principles of Heredity. William Bateson.
The Mutation Theory. Hugo de Vries.
Species and Varieties. Their Origin by Mutation. Hugo de Vries.
The Evolution Theory. August Weismann.
Man's Place in Nature. Thomas H. Huxley.
Darwinism Today. Vernon L. Kellogg.
Origin and Evolution of Life. Henry Fairfield Osborn.
Evolution and Animal Life. David Starr Jordan and Vernon L. Kellogg.

HISTORY



HISTORY occupies a more important place in the field of knowledge today than it has ever occupied before. International problems have captured the public interest and have become matters of practical concern the world over. We have come to realize that the traditions, ideals, and political relations of other nations and other peoples, no matter how remote, can often become of vital significance to us. If we are to form sound opinions upon world affairs, we must know the historical background of world politics. This link of the present with the past extends to all human affairs. We shall understand the social and economic questions of our own times far better if we are able to trace their origin and their development down the ages. History, as it is taught and written today, is no longer a narrative of isolated incidents, of wars, of intrigue, of marriages and deaths of kings and queens, or of the detached deeds of famous men and women. It is on the contrary an account of the origin and development of human institutions and ideas. It deals with the conditions under which ordinary men lived in various ages and countries; it deals with their customs, arts, and ideals; with the growth of law and government; and with the influence of leaders upon the fate of peoples. At all times it seeks material on which to base general principles of human conduct, so that we in the present may profit by the mistakes and successes of the past.

ANCIENT HISTORY

The Dawn of Civilization

I. PREHISTORIC PERIOD: For thousands of years before the oldest kind of writing was invented, men and women and children had been working and playing in many parts of the world. By carefully studying the things they have left us—stone tools, pieces of pottery, and pictures on cave walls—we have learned a great deal about the way these people lived and can trace the almost unbelievably slow steps by which they learned the arts of civilization. Because they lived before there was any *written* history, we call them prehistoric men.

- **A. Primitive Man: 2133–4.**
  - **a. Old Stone Age (Paleolithic Age): 3360–1, 771.**
    - **1.** Cave Dwellers: 666, 668.
    - **2.** Remarkable artistic ability shown: 2627; drawings: 2628 (picture).
  - **b. New Stone Age (Neolithic Age): 3361.**
    - **1.** Beginnings of settled life and division of labor: 771–2.
    - **2.** Interesting remains: Lake Dwellers 1957; in Egypt 1098.

B. Dawn of History with Bronze Age:

- **a. Discovery of Metals Quickens March of Progress: 772–3.** Relics found 515 (picture).
- **b. Invention of Writing Ends Prehistoric Age: 773, 1654.**

II. DEVELOPMENT OF CIVILIZATION ALONG THE NILE: 1098.

A. Favorable Situation of Northern Eygpt: 1092. The fertile strip of the Nile Valley sheltered on all sides by deserts and the sea was an ideal situation for the beginnings in civilization. The rich soil brought down by the Nile supported a dense population; the river itself was a great highway; the quarries of the nearby deserts furnished unlimited building materials.

B. Great Epochs of Egyptian History:

- **a. Long Period of Early Development Culminating in the Union of Upper and Lower Egypt: 1099.**
- **b. Pyramid Age: 1099–1102.** The building of monumental Pyramid tombs to gratify the vanity of the Pharaohs which became the dominant interest, exhausted the wealth, and took a terrific toll of the slave labor: 2939–40, 568–9, 176, 570, and 1094 (picture).
- **c. Feudal Period—when Nobles Ruled Vast Estates: 1102.** During a long struggle between rival rulers and sections Egypt became so weak that it fell before foreign conquerors, the Hyksos or Semitic "Shepherd Kings": 1102.
- **d. Defeat of Shepherd Kings and Rise of the Empire: 1104–6.**
  - **1.** Egyptian nobles revolted against the Hyksos and drove them out (about 1600 B.C.).
  - **2.** Great Temple of Karnak crowned revival of art: picture facing 176.
- **e. Fall of the Empire: 1106.** Pursuing the Shepherd Kings into Asia, the Egyptians began a period of foreign conquest, which for many centuries added to Egypt's glory, but which finally led to the invasion and subjugation of Egypt, first by the Assyrians (670 B.C.) and later by the Persians (525 B.C.). With these invasions ended the period of distinctive Egyptian culture.

Note: The Egyptian rulers are often grouped into dynasties beginning with Menes (3400 B.C.). The IVth Dynasty marked the height of the Pyramid Age; the XVIIIth began, and the XXXIst ended the Imperial Period.

C. How the Ancient Egyptians Lived:

- **a. Their Religion:**
  - **1.** Belief in a life after death shown by careful preservation of bodies (mummies), and building of suitable tombs: 1099, 2369, 1102, and 1104 (pictures).
  - **2.** Important gods: 1832, 2602, 1106.
  - **3.** Sacred animals: 369, 658, 923, 1106, 1410, 2286, 3364.
  - **4.** Priesthood: 1104, 2193.
- **b. Industrial Life: 1100.** Agriculture 48, 3732; Boats and ships 3207, 3524, 3525 (picture); Bread, 496; Brick-making 503; Enameling 1145; Fisheries 1282; Furniture 1383; Harps 1589; Beasts of Burden 1684, 1685, 3524; Ink 1780; Papyrus 2674, 2666; Spinning and Weaving 3326, 904; Water-clock 797; Mining 2251, 1479; Canals and Irrigation 625, 1828.
- **c. Art and Science: 1100, 1102.** Architecture 176, 2939–40, 1104, 178 (picture); Astronomy 239; Books 455; Language and Writing 1098–9, 3816, 3817, 1649, 2666, 2710 (picture), 101 (picture); Beginnings of Mathematics 93, 1422; Painting 2627, 2629 (picture); Sculpture 3155, 3316–7, 1103–6 (pictures), 1206, 3155 (picture).

III. EARLY CIVILIZATIONS OF WESTERN ASIA: That part of Asia which we call today the Near East, consisting of Asia Minor, Syria, and the Arabian Peninsula, was the ancient home of civilizations which were of immense importance because of their profound influence upon subsequent culture and history. These civilizations grew up in what has been called the Fertile Crescent, consisting of that borderland between the mountains in the north and the Arabian desert where crops could be grown and cities could be built.

A. Mesopotamia—the Eastern Part of the Fertile Crescent: 2200–1.

- **a. Sumerian Culture:** The Sumerians (a non-Semitic people) in their group of city states along the Tigris and Euphrates Rivers originated the characteristic culture of Mesopotamia which was to endure through centuries of conquest (295).

  —Cuneiform Writing 939; oldest known Library 1992; Phalanx 297 (picture).
- **b. Babylonian Empire: 295–7.** Established by Semitic tribes who conquered Sumerian cities. The conquerors absorbed and modified the Sumerian culture, developing a highly organized social and political system.

  —Architecture 176; Brick and Tile 502–3; Street Paving 3023; Education 294; Writing 294, 3817 (picture); Engraved Seals 1410; Origin of Seven-day Week 3713; Invention of Sundial 797.
- **c. Assyria Absorbs Babylonia in Great Assyrian Empire:**
  - **1.** Improvements in art of warfare make possible the conquest of a vast military empire **297–8;** introduction of iron weapons increases fighting efficiency 1817.
  - **2.** Conquest of Hittites and Israelite Tribes: 1669, 1890.
  - **3.** Nineveh, the capital built by Sennacherib 298, 2510; destruction by the Medes 2191.
  - **4.** Artistic advancement especially marked by Sculptures depicting the conquests 298, **3155–6,** 296 (picture), 1206 (picture); use of Stone in Building 176; Painting 2628; Engraving 1168; Library at Nineveh 1992.

Note: It is important to keep in mind that slavery was an essential part of all ancient civilizations; the conquered people formed the slave class and without them the great construction projects would have been impossible.

- **d. Chaldean Empire—Last Semitic Empire: 298.**
  - **1.** Babylon rebuilt 298, 294, 176; Famous Hanging Gardens 3177–8, 3179 (picture); Nebuchadnezzar's Canal 625, 1187.
  - **2.** Babylonian Captivity of the Jews, which did much to advance Hebrew culture: 1891.
- **B. Syria—The Western End of the Fertile Crescent: 3425–6.**
  - **a. Phoenicians—the Early Traders who Carried the Alphabet to all Civilized Lands: 2773–4.** Although they had built their cities on the "battle-ground of empires" these peaceful merchants suffered little from the successive conquests, for they were content to pay tribute to any conqueror as long as they were allowed to continue their trading enterprises.
  - **b. Hebrews—A People who Retained an Intense Racial and Religious Unity Despite Conquests and Oppression: 1889–92.**
    - **1.** Nomadic Wanderings begun by Abraham 2–3; terminated by Moses 2333.
    - **2.** Kingdom established under David and his son Solomon 967, 3274; capital is Jerusalem 1886.
  - **c. Philistines: 2770.** These cousins of the Cretans are the enemies of the Israelites of whom we read so much in the Bible.
- **C. Asia Minor:**
  - **a. Hittites: 1669.** Through their wars with the Hittites the Assyrians and Egyptians learned the use of iron for tools and weapons 1817, and the value of the horse 3524.
  - **b. Lydians:** These people of Asia Minor rose to such prosperity that the name of their king, Croesus, is still the symbol for fabulous wealth 923; earliest known use of coins 2281.
- **D. Indo-European Supremacy Supplants Semitic Power:** The Indo-European races moving southward from the mountains north of the Fertile Crescent belonged to the same race as the peoples of modern Europe.
  - **a. The Medes: 2191.**
  - **b. The Short-lived Persian Empire: 2737.**
    - **1.** Religion of Zoroaster, the first universal religion: 3841.
    - **2.** Rising power of Greece stays westward tide of Persian conquest: 2738–40.
    - **3.** Alexander's conquest ends great Asiatic Empires: 86–7.

The Greeks

- **I. THE RISE OF EUROPEAN CIVILIZATION:**
  - **A. Aegean Civilization: 27–9, 918.** This civilization developed in Crete and spread over the Aegean World.
    - **a. Effect on European Civilization: 1517, 27 map.** The islands of the Aegean were the stepping stones that brought civilization to Europe.
    - **b. Discoveries of Archeologists:** Excavations of Henry Schliemann unlock storehouse of unsuspected treasures 3138, 3545, 29.
- **II. GREEK INVASION OF THE AEGEAN WORLD:**
  - **A. Nomad Tribes from the North: 1518, 1520, 29.** The Greeks came down from the unknown North and conquered the Aegeans; in settling down they adopted much of the Aegean culture. The Greeks were a northern branch (Indo-European) of the same stock as the Medes and Persians (Indo-Iranians) who had invaded the Semitic world of western Asia.
  - **B. Homeric Age Marks the High Tide of the Migration: 1520.**
    - **a. Trojan War: 3542–3.**
    - **b. Culture of the Acheans:** An account of the culture of these early Greeks is preserved for us in the Iliad and Odyssey of Homer 1520, 1675–6.
- **III. DEVELOPMENT OF GREEK CITY STATES:**
  - **A. Lack of Unity among the Greeks:** This is the keynote of Greek political history, and was largely due to geographical influences 1517–8, 1520.
  - **B. Evolution of Democracy: 1520–2.**
    - **a. Athens, the Intellectual Leader of Greece: 1521–2.**
      - —Reforms of Solon make Government more Democratic: 3274–5, 3655.
    - **b. Sparta, the Military State: 3308–10.**
      - —Lycurgus, the great law-giver: 2086.

  Note: It must be remembered in discussing Greek Democracy that it was limited to an aristocratic class, the citizens of the states. In the Greek cities every man was not a citizen as is the case in most countries today; the greater part of the menial and skilled labor of Greece was done by slaved and free men who were not members of the exclusive body of citizens 1522, 3309.
- **IV. PERSIAN WARS:**
  - **A. Greece Checks Persian Invasion and Saves Europe from Asiatic Domination: 2738, 1522.**
    - **a. Famous Battles:** Marathon 2144; Salamis 3113, 195; Thermopylae 3487.
    - **b. Leaders:** Themistocles 1522; Aristides 194.
  - **B. Results of the Wars:** They led to the foundation of the Delian Confederacy which became the Athenian Empire 195, 1522.
- **V. AGE OF PERICLES OR THE "GOLDEN AGE" OF GREECE: 1522, 1524, 2729.**
  - **A. "Plain Living and High Thinking" in Ancient Athens: 1522, 1524.**
  - **B. Far-Reaching Effects of this Period:** It served to crystallize all the previous culture of Greece; it stimulated new and immortal achievements; and it established such high and firm standards in art, literature,

and philosophy that Greece continued to be the intellectual leader of the world long after the political power of the Greek states was broken.

- VI. CULTURE OF THE GREEKS:
  - A. **Literature: 1534.**
    - a. **Poetry: Homeric Epics 1675, 3542; Lyric Poetry 1536.**
    - b. **Drama Evolved from Dialogues and Choruses of Religious Festivals: 1031, 1536.**
      - 1. Aeschylus, Sophocles, Euripides, and Aristophanes: 1536–7.
      - 2. Greek Theaters: 3482, 3484.
    - c. **Prose Developed by Historians and Orators: 1537, 3004–5.**
      - 1. Herodotus, the "father of history": 1645.
      - 2. Demosthenes, greatest of orators: 993.
  - B. **Art and Architecture: 1529, 176.**
    - a. **Phidias, the Master Sculptor and Builder: 2759.**
    - b. **Glories of the Acropolis: 10, and 248, 250, 1517, 1532** (pictures).
  - C. **Music Among the Greeks: 2376.**
  - D. **Influence of Religion on Greek Life: 2385, 3607.** A survey of the Greek gods and goddesses will be found in the Mythology Outline.
    —Olympic Games 2580; Oracles 156, 991.
  - E. **The Work of the Philosophers: 1537–8.**
    —Socrates 3270; Plato 2832; Aristotle 195.
- VII. CIVIL WARS AND DECLINE OF THE POWER OF THE CITY STATES: **1524–5.**
  - A. **Peloponnesian Wars Establish Spartan Supremacy: 3310, 251.**
  - B. **Leadership Passes to Thebes: 3485.**
- VIII. GREECE UNDER MACEDONIAN RULE:
  - A. **Philip of Macedon Builds up a Great Military Power: 1525, 2096.**
  - B. **Alexander, Philip's Son, Becomes a World Conqueror: 85–87.**
    - a. **Subjugation of Persian Empire, Including Egypt: 86–87, 2738, 2774, 1106–7.**
    - b. **Alexander Carries Greek Culture to Most of Known World: 1525, 251.**
  - C. **Sunset Glory of Greece—the Hellenistic Age: 1525–6.**
    - a. **In Egypt: 1107, 2931, 789.**
      —Alexandria becomes literary and scientific capital of world: 88, 1992.
    - b. **Art and Literature of Hellenistic Age: 1532, 1538.**
    - c. **Development of Science: 1422, 1064, 1416, 174, 2931.**
- IX. GRECIAN WORLD ABSORBED BY ROMAN EMPIRE: **1525–6.**

Rise and Fall of the Roman Empire

- I. BEGINNINGS OF ROME:
  - A. **Sunny Italy—the Generous Mistress of the Mediterranean: 1835.** Italy was more hospitable to the enterprises of men than Greece. The ridge of the Apennines near the Adriatic Coast was a high garden wall which kept curious easterners from trespassing; the sunny hillsides sloping to the western Mediterranean could support a large population; communication was not difficult. If the lack of good harbors tended to keep the early Romans at home, it also kept invaders away.
  - B. **Inhabitants of Ancient Italy:**
    - a. **The Etruscans: 1185.** These were perhaps related to the Cretans.
    - b. **The Latins: 3040.** These people entered Italy from the north in prehistoric times and belonged to the same stock (Indo-European) as the invaders of Greece.
  - C. **Founding of Rome:** Nothing definite is known of the founding of Rome, as there is little historical evidence to support the legends of Aeneas or of Romulus and Remus 29, 3058.
  - D. **Progress and Prosperity of Rome under Etruscan Rule: 3041.**
  - E. **Etruscan Kings Expelled: 3041.** Story of Horatius 3494.
- II. THE REPUBLIC:
  - A. **Long Fight Waged by Common People (Plebs) against the Ruling Aristocracy (Patricians) for Political Power: 3042–4.**
  - B. **Military Conquest and Territorial Expansion:**
    - a. **All Italy Comes Under Roman Rule: 3044.**
      - 1. Defeat of Pyrrhus at Beneventum leads to capture of Greek colonies: 2941.
      - 2. Wise political organizations of conquered territories aids governmental stability: 3045.
      - 3. Story of Cincinnatus: 766.
    - b. **Triumph in Punic Wars Gives Rome Naval Supremacy: 3045–6.**
      - 1. Carthage—Its Rise and Fall: 650.
      - 2. Hannibal—a Genius in Victory and Defeat: 1575.
    - c. **Other Conquests:** With Carthage defeated, the way was now clear for the conquest of a Mediterranean empire; victory followed victory, and sooner or later most of the known world fell before the Roman legions: Syracuse 175; Spain 3303; Greece 1525–6; Pompey in the East 2878, 1891; Gaul 1352, 1445–6, 564, 674.

- C. Collapse of the Republic:
  - a. **Causes of the Collapse: 3046.** Here again crops out that fundamental weakness of the ancient civilizations, the slave systems. The rich grew richer and the poor grew poorer, until they were worse off than the actual slaves in the rich man's home. The flooding of the slave market with military captives made the employment of free labor unprofitable. There was no stablizing "middle class," no newspapers, and no national school system to enlighten the public.
  - b. **Civil War, a Period of Personal Rivalries and Class Struggle: 3046.** During this scene many famous characters come onto the stage of history: Cicero 765; Pompey 2878; Antony and Cleopatra 789.
  - c. **Julius Caesar Masters the Roman World and Becomes "Imperator": 564, 3046.**

III. THE EMPIRE:

- A. First Century of Imperial Glory: **3046–7.**
  - a. **Augustus Encourages Era of Intellectual and Imperial Development: 257–8.**
  - b. **The Infamous Nero, the last of the Augustan Line, Ends the Century: 2436.**
- B. Second Century of Imperial Glory—Empire Reaches Greatest Extent: **3047–8, 3042** (map).
  - a. **Conquest of Britain: 1152.**
  - b. **Rule of Blood and Iron:** Destruction of Jerusalem 1891; Annihilation of Palmyra 2648.
  - c. **Ends with Marcus Aurelius, the Emperor-Philosopher: 2146.**
- C. Life in Imperial Rome:
  - a. **Luxury the Keynote of Roman Life:** Everyday affairs in Pompeii 2875; classic fashions 879, 898 (picture); performances of gladiators 1466.
  - b. **Practical Progress:**
    1. Modern improvements two thousand years ago: public baths 3052; sewerage systems 3183; aqueducts and water supply 163–4, 3702; tunnels 3552; dentistry 997; utensils 3045 (picture).
    2. Greatest system of communication in the ancient world: roads 3046, 3526; postal service 2896; lighthouses 2004.
  - c. **Artistic Achievements:**
    1. Roman architects modify Greek style and develop engineering technique: 177–8, 1149.
    2. In sculpture and painting, also, the Romans followed Greek models: 1532–3.
  - d. **Literature: 1966–8.**
    1. Golden Age of Latin Literature: 1966–7; Cicero the great stylist 765; Vergil the poet 3630.
    2. Silver Age: 1967–8. Provincial writers came to the front 3303; 'Meditations' of Marcus Aurelius, a classic of all ages 2146.
  - e. **Religion:** In religion, too, the Romans borrowed from the Greeks. For a survey of Roman gods and goddesses consult the Mythology Outline.

IV. DECLINE AND FALL OF THE EMPIRE:

- A. Internal Decay:
  - a. **Emperors under Control of Army: 3048.**
  - b. **Constantine Ends the Political Power of Rome by Removing Capital to Constantinople: 870.**
    1. This paved the way for the formal division of the Empire: 1194.
    2. Justinian I preserves Roman Law in famous code: 1905.
  - c. **The Byzantine Empire at Constantinople: 551.** This empire is chiefly interesting in connection with Roman history because it preserved for posterity the classic culture that was destroyed in Rome.
- B. **The Coming of the Barbarians:** Beyond the last Roman outposts was ever a throng of restless people eager to push into the southern lands of sunshine and plenty. Centuries before, the Gauls had ravaged Italy and even sacked Rome 3044. With the weakening of the Roman military power these tribes began to pour into the Empire 1194, 1491.
- C. Fall of Rome:
  - a. **Visigoth Victory at Adrianople Foreshadows Doom of Rome: 26.**
  - b. **Rome is Captured by Alaric: 73.**
  - c. **Pope Leo I Saves City from Ravages of Huns under Attila: 1704.**
  - d. **Theodoric, the Ostrogoth, Establishes Short-lived Rule in Italy: 1491, 2979.**
  - e. **Vandals Plunder by Land and by Sea: 3617.**
  - f. **Lombards Found Kingdom in Northern Italy: 2047.**
- D. **The Christian Church Takes up the Burden Dropped by the Dying Empire: 763.**

MEDIEVAL HISTORY

I. CHARLEMAGNE'S EMPIRE:

- A. **The Foundation of the Frankish Empire:**
  - a. **Clovis Unites all Franks and Conquers Modern France: 1352, 810.** The conversion of Clovis to Orthodox Christianity was significant; it led to Frankish support of the Pope, whereas many of the other barbarians had tried to destroy the power of Rome.
  - b. **Charles Martel Saves Europe from Mohammedan Conquest at Tours: 697.**
- B. **Charlemagne, the Empire Builder of the Middle Ages: 688.**
- C. **Disruption of Charlemagne's Empire, the Starting Point of Modern Germany and France: 1195, 1352.** Charlemagne's son, Louis the Pious, was unable to maintain order in the vast domain left him, and upon

his death his three sons divided the lands between them—the Partition of Verdun. Louis the German received the portion beyond the Rhine; Charles the Bald, that west of the Rhone and Scheldt; Lothair, the middle strip including Italy. While these divisions soon yielded to the disintegrating influences of the feudal age, they were later partly revived.

II. THE MEDIEVAL CHURCH:

- A. **The Bishop of Rome, as Pope, Becomes the Most Powerful Ruler of the Middle Ages: 2664, 763.**
- B. **The Work of the Monks and the Monasteries: 2298, 455–6.**
  - a. **Missionary Enterprises: 636, 454, 1447.**
  - b. **The Friars 2300; Franciscans 1355.**

III. FEUDALISM:

- A. **The Result of the Collapse of the Roman Government: 1235.**
  - a. **General Causes of Feudalism:** This system was not peculiar to Europe; it has often grown up in countries where the central government has been weak: Egypt 1102; Japan 1868.
  - b. **The Castle, the Stronghold of Feudalism: 654.**
  - c. **Rule of "Might Makes Right":** In England 3352; in France 2064; in Germany 1447.
- B. **Life under the Feudal System:**
  - a. **"When Knighthood was in Flower": 1933.**
    - 1. Armor 214; heraldry 1639.
    - 2. Life in the castle 656; the importance of the minstrels 3039; 2377; courtly sport of falconry 1220.
  - b. **Country Life in Feudal Days:** System of land holding 1235; dependent position of serfs 3249; agricultural methods 48, 44 (picture).
  - c. **Town Life in Feudal Days: 769, 373, 1358.** Fairs and markets 1219; Flemish trade 372, 376; Hanseatic League 1576; trade with the East 904, 3317, 3385, 2723; gilds, the medieval forerunner of the trade unions 1459.
- C. **Decline of Feudalism: 1236.** Rise of the power of the towns 769–70; Black Death breaks down agricultural system 433; effects of Crusades 932; invention of gunpowder 1552; rise of infantry and professional armies 42, 1700; inventions which changed the tide of power 773.

IV. CULTURAL DEVELOPMENT OF THE MIDDLE AGES:

- A. **Literature Embodied in Minstrels' Songs: 3039, 2377, 2539.**
  - a. **Modern Survivals:** Tales of King Arthur 223; Robin Hood 3028; Song of Roland 3038; Reynard the Fox 1337.
  - b. **Froissart the Chronicler: 1375.**
  - c. **Books and Libraries: 455–6, 1992.**
- B. **Beginnings of the Modern Drama:** Pageants 2625; Miracle and Mystery plays 1033, 2259.
- C. **Architecture and Art:**
  - a. **The Soaring Gothic Architecture, the Embodiment of Medieval Idealism: 181.** Cathedrals 662; stained glass 1474; sculpture 3156.
  - b. **Other Arts:** Painting 2628; tapestries 3433, 1140; ivory carving 1854; illumination of books 455–6.
- D. **Living Conditions:** Meager house furnishings 1383; floor coverings 3079; poor heating systems 3368; insanitary sewerage 3183; inadequate water supply 3702; table utensils 1937; limited diet 3317.
- E. **Education Carried on by the Church: 763.**
  - a. **Medieval Universities: 831, 2608, 450, 2390.**
  - b. **Importance of Abelard 2; Roger Bacon 301.**

V. THE CRUSADES:

- A. **The East at the Time of the Crusades:**
  - a. **Byzantine Empire, the Stronghold of Culture in Europe: 551.**
  - b. **Rising Tide of Mohammedanism: 2275, 1942.** Movement into Europe through Spain 2323, 3302; checked at Tours 697.
- B. **The Crusades: 929.**
  - a. **Causes of the Crusades:** Seljuk Turks capture Jerusalem, threaten Constantinople, and stop pilgrimages to Palestine 929; pilgrimages—an important feature of medieval life 2807.
  - b. **General Character of the Crusades:**
    - 1. Famous leaders: Richard the Lion Hearted 3015; Saladin 3111; Louis IX of France 2064; Frederick Barbarossa 1358; Philip Augustus 2762.
    - 2. Corruption into economic crusades: 552, 3625, 918, 947.
    - 3. Part played by Crusading Orders: 932, 930, 2131.
- C. **Effects of the Crusades upon Europe: 932.** Agriculture improved by introduction of new plants 2278, 1674; use of Arabic notation 2543; influence on architecture 181.

VI. GROWTH OF MONARCHY IN FRANCE:

- A. **Capetian Kings Begin Unification of France: 1195, 1352.** When Hugh Capet came to the throne, feudalism was at its height; the kingly power was disputed by great barons of whom the duke of Normandy was the most powerful; Henry I fails to subdue vassals 1636; how the Northmen conquered Normandy 2513, 2526.
  - a. **Louis the Fat Brings Order to France by Defeating Feudal Barons: 2064.**
  - b. **Philip Augustus Conquers Normandy from John of England: 2762, 2513.** Normandy became an English possession when the duke of Normandy became king of England 2513.
  - c. **Administrative Reforms of Louis the Saint: 2064.**
  - d. **Philip the Fair: 2762.** Calls the first Estates-General 1178.

- **B. Hundred Years' War: 1699.**
  - **a. Causes of the War: 1699.** English claims to France 2763.
  - **b. How the War was Fought:**
    - **1.** Royal leaders: 694, 1088, 1634.
    - **2.** Important battles: Crécy 1699, 635, 1552; Poitiers 1700; Agincourt 42, 1634; first use of cannon 635–6.
    - **3.** How Joan of Arc Saved France: 1893, 694.
  - **c. Results of the War: 1700, 1352, 1634, 2763.**
- **C. Growth of Absolute Monarchy under Louis XI: 2065, 220.** Defeat of Charles the Bold, the powerful duke of Burgundy 697.

VII. ENGLAND IN THE MIDDLE AGES:

- **A. Early History:**
  - **a. Roman Briton: 1152.**
  - **b. Anglo-Saxon Period:** Teutonic invasion 1152, 674; Christianity returns 636; Alfred, the first great English king 90; Danish Invasions 1152, 90, 1087; Canute rules all England 639; Edward the Confessor restores Saxon line 1087.
- **B. Norman Conquest:**
  - **a. Normans under William the Conqueror defeat Harold at Hastings: 3739, 1595.** Death of Harold, last Saxon king 1589.
  - **b. Norman Rule Established: 1153.** Feudalism reaches height under Stephen 3740, 1633, 3352.
  - **c. Results of Conquest:** While the Norman Conquest brought continental influences to England, in the end the Normans became English 2513.
- **C. Growth of Constitutional Government: 1153.** In this connection it should be thoroughly understood that in England there is no written constitution similar to that of the United States. There, constitutional government means government according to a body of laws, customs, and court decisions that have gradually become established by centuries of usage.
  - **a. Beginning of Systematic Government under Henry II: 1633.**
    - **1.** Attempt to regulate the clergy fails 358; jury trials extended 1905.
    - **2.** Administrative methods continued by Richard I: 3015.
  - **b. Magna Carta, the Great Charter that Made the King Amenable to the Law: 2121.** Extorted from John by rebellious barons: 1895.
  - **c. Growth of Parliamentary Power:**
    - **1.** How Simon de Montfort called the First Parliament 2316, 2687; Result of Barons' war against Henry III: 1634.
    - **2.** Model Parliament, so called because it was model for succeeding parliaments 2687; Edward I encourages idea of law and order 1087.
    - **3.** Parliament divided into two houses: 2687.
    - **4.** Parliament, under Edward II, begins to restrict the power of the king 1088; quarrels with Richard II: 3016.
- **D. England Reaches out for More Territory:**
  - **a. Edward I Attempts to Unite Scotland and England 3148, 1088.** Resisted by Wallace and Bruce, great Scotch heroes: 3667, 518.
  - **b. Conquest of Wales: 3664, 1087.**
  - **c. In France, the Loss of Normandy under John Left Aquitaine Chief English Possession: 1088, 2513.**
- **E. Struggle for Social Justice—Beginning of Conflict between Capital and Labor:** Black Death causes decline of serfdom 433; Peasants' Revolt 3571.
- **F. Birth of a National Spirit:**
  - **a. Effect of the Hundred Years' War:** This long struggle was largely carried on by the English people united by a common interest, not by a body of personal retainers to further the designs of some feudal lord. The success of their military operations was due to the English archers, who were sturdy yeomen, the foundation of Britain's great middle class.
  - **b. English Becomes the Official Language: 1162.**
  - **c. Beginnings of a National Literature: 1163.** Chaucer, the Father of English Poetry 701; Wyclif's English Bible 3817.
- **G. Wars of the Roses: 3066, 3016, 1635.** Resulted in establishing of powerful Tudor monarchy 3547; Court of Star Chamber 3344.

VIII. THE EMPIRE AND THE PAPACY:

- **A. The Beginnings of the Holy Roman Empire: 1674.**
  - **a. Coronation of Charlemagne, the "Central Fact of the Middle Ages": 688.**
  - **b. Character of the Conflict between Popes and Emperors: 1674.** Since both Pope and Emperor claimed that their power was derived from God, a difference in interests was bound to lead to a conflict.
  - **c. Revived under Otto I: 2606, 1842.** For the next few centuries the history of Germany and Italy became that of the Empire and the Papacy.
- **B. Great Investiture Conflict:**
  - **a. Begun by Henry IV and Pope Gregory VII (Hildebrand): 1632, 1541.** Settled by Concordat of Worms 1633.
  - **b. Conflict in England: 3740.**

C. **Quarrels of the Hohenstaufens and the Popes:**
  a. **Fundamental Causes:** The secret of the hereditary feud lay in the fact that the office of Emperor was at least theoretically elective, and the Guelfs disputed the claims of the Hohenstaufens (Ghibellines). Since the coronation of the Emperor by the Pope was necessary to the imperial power, the Pope was forced to take sides in the disputes. It was inevitable that he should generally oppose the Hohenstaufens who were the most formidable rivals of the papacy in the struggle for power 1546.
  b. **Frederick Barbarossa, One of the Greatest of the Emperors: 1358.**
  c. **Innocent III strengthens the Papal Position: 1780.**
    1. Humbles John of England: 1896.
    2. Dominates selection of Emperors: 2606.
  d. **Frederick II Restores Hohenstaufen House: 1358.** Cultural development of this period in Naples and Sicily 2391, 3230.
D. **Golden Bull Establishes a "Constitution" for the Empire: 1675.** Hinders growth of centralized government in Germany 1447.

IX. **FALL OF THE EASTERN (BYZANTINE) EMPIRE:**
  A. **Rise of the Ottoman Turks: 3559.**
  B. **Fall of Constantinople: 871, 552, 3559.** This put an end to the Bzyantine Empire and gave the Turks undisputed control of the eastern Mediterranean and of a large corner of Europe; but indirectly it stimulated the era of exploration and discovery by forcing western Europe to abandon the old Mediterranean trade routes and seek new ways of reaching the Far East.

MODERN HISTORY

The Renaissance

I. **FORERUNNERS AND CONTRIBUTING CAUSES:**
  A. **Crusades—Contact with Eastern Culture Stimulated Thought of Crusaders: 932.**
  B. **Invention of Printing and More General Use of Paper Promoted Interchange of Ideas: 2916, 2667.**
  C. **Growth of Creative Impulse as Shown in Medieval Architecture: 182, 184.**

II. **LITERARY RENAISSANCE:** Study of classical learning and beginnings of national literatures 2995.
  A. **In Italy: 2995–6, 1832–3.**
    a. **Dante the Forerunner of the Renaissance: 957.**
    b. **Distinctly National Literature Hampered by Revival of Greek and Latin: 1833.**
  B. **North of the Alps: 2996.**
    a. **France: 1364. Froissart the chronicler 1375.**
    b. **England: 1163–4, 1635.** Early influence of Chaucer and Wyclif on English language 702, 3817; Sir Thomas More and the Oxford Reformers 2325.

III. **ARTISTIC RENAISSANCE:**
  A. **In Italy: 2996–7, 2628–30, 3156–8.**
    a. **Florence the Center of the Movement: 1293–4.** Patronage of the Medici 2191.
    b. **Italian Masters:** Giotto 1461; Ghiberti 1456; Leonardo da Vinci 3643; Michelangelo 2220; Raphael 2976; Titian 3504–5.
    c. **The Church a Patron of Art:** The Borgias 467; Pope Julius II 1902; Leo X 1988.
  B. **Northern Artists: 2997.** Dürer 1048; Holbein 1672.
  C. **Architecture:** Return to the classic styles: 188.

IV. **BEGINNINGS OF SCIENCE:**
  A. **Roger Bacon, Who Foreshadowed Experimental Science: 301, 2787, 712 (picture).**
  B. **Advance in Astronomy: 773, 774.**
    a. **Copernicus, the Founder of Modern Astronomy: 880.**
    b. **Galileo Continues Work of Copernicus: 1391, 1508, 2787.**
  C. **Important Inventions: 773. Compass 853, gunpowder 1552.**

V. **EXPLORATIONS AND DISCOVERIES: 1416, 773.**
  A. **Prince Henry the Navigator and the Portuguese in the East: 1638–9.**
    a. **Bartholomew Diaz Discovers the Cape of Good Hope: 640, 3279.**
    b. **Vasco da Gama Reaches India: 1392.**
  B. **Columbus Discovers America: 846.**
  C. **Magellan Circumnavigates the World: 2115.**

Note: In the Geography Outline under the section devoted to each continent will be found further references dealing with the discoveries, explorations, and colonial enterprises of this and later periods.

The Reformation and Religious Wars

I. **CAUSES OF THE REFORMATION:**
  A. **Effect of the Renaissance: 2996.** Social and political unrest in Germany 2987; printing and translation of Bible into National Languages 389.
  B. **Forerunners of the Reformation:** Wyclif and the Lollards 3817; John Huss attacks corruption of the Church in Bohemia 1705; influence of the conservative Erasmus 2996.

II. POLITICAL AND SOCIAL CONDITIONS OF EUROPE:
A. Consolidation of Spain: 3304.
a. Marriage of Ferdinand and Isabella: 1832.
b. Moorish Power Broken: 2323.
c. Charles V Rules the Holy Roman Empire and all Hapsburg Possessions: 690. The problem of defending his vast dominions against outside attack kept Charles from dealing effectively with the social and religious ferment within 2988, 1195.
B. French Designs on Italy: 696, 1354.
a. Battle of Ravenna: 2979.
b. Savonarola Preaches Moral and Religious Revival: 3130.
c. Invasions of Italy Distract Attention from Religious Revolt: 1195.
III. REFORMATION BEGINS IN GERMANY:
A. Why Germany was Ready for the Reformation: 2987.
B. Luther and His Teachings: 2084, 2987.
C. Peace of Augsburg Ends Civil Wars: 2988. Since this peace left to each ruler the right to establish either Lutheranism or Catholicism, the people who disagreed with their rulers were forced to emigrate.
IV. CALVINISM:
A. In Switzerland:
a. Zwingli Preaches Radical Reform: 3842. In the disagreement between Zwingli and Luther lay the germ of much future Protestant dissension.
b. Calvin and His Austere Teachings: 587.
B. Huguenots in France: 1696.
a. Persecutions and St. Bartholomew's Massacre: 1637, 826, 696.
b. Henry IV and Edict of Nantes: 1696.
c. Richelieu Destroys Political Power of Huguenots: 3018.
C. In Scotland: 3148.
—John Knox Founds Scotch Presbyterianism: 1941.
V. REFORMATION IN ENGLAND:
A. Henry VIII's Divorce Case Leads to Break with Rome: 1636, 3776.
a. Opposition of Thomas More: 2325.
b. Underlying Issues: The changes under Henry VIII had to do with Papal control rather than religious reform 1636; Protestant doctrines had little influence before Edward VI. 1089.
B. Catholic Reaction under Queen Mary: 2157, 1136. Tragedy of Lady Jane Grey 1542.
C. Elizabeth Secures England's Position as Protestant Kingdom: 1136.
a. Mary Queen of Scots, Center of Catholic Movement: 2158.
b. Defeat of Spanish Armada: 210. This marked the beginning of British sea-power 1030, 2763.
c. Elizabethan Age in Literature: 1164, 2539. Shakespeare 3188; Francis Bacon 300.

Period of Civil Strife

I. QUARRELS IN ENGLAND BETWEEN STUART KINGS AND PARLIAMENT:
A. James I Attempts to Rule by "Divine Right": 1860.
B. Charles I Continues the Policy: 691-3. John Hampden leads resistance to ship money 1570; Long Parliament begins 2689.
C. Failure to Settle Religious Question:
a. Gunpowder Plot to Blow up Parliament: 1228.
b. Persecution of Puritans and "Great Migration": 2937, 2175.
c. Bishops' Wars in Scotland: 3148.
II. CIVIL WAR, COMMONWEALTH, AND PROTECTORATE:
A. Parliament Leads War Against King: 924–5, 693, 3149. Scotland aids Parliament: 3148–9.
B. Cromwell in Power: 924. King Charles is put to death 693.
a. Irish Rebellion Crushed: 1808.
b. Growth of Sea-Power in War with Netherlands: 435, 2442.
III. THE RESTORATION:
A. Charles II Seeks Absolute Power: 694. Habeas Corpus Act Passed 1557.
B. James II's Attempt to Secure Catholic Restoration Brings Revolution: 1861. Stuart Claims upheld by "Pretenders." 2914.
C. Age of Puritan and Cavalier in Literature: 1164–5.
a. Influence of King James' Bible: 389.
b. Great Puritan Writers: Milton 2240, Bunyan 534.
IV. SPAIN AND THE REVOLT OF THE PROTESTANT NETHERLANDS:
A. Catholic Policy of Philip II: 2763, 3304.
B. Dutch Fight for Independence: 2442, 520. William the Silent 3741; Treaty of Westphalia 3489.
V. COUNTER-REFORMATION:
A. Earlier Attempts of Churchmen to End Abuses: Savonarola 3130; Ximenes 3823.
B. Reformation within the Catholic Church: 2989. Loyola and the Jesuits 2075; Francis Xavier 3823.
C. The Work of the Inquisition: 1780.

- VI. THE THIRTY YEARS' WAR:
  - A. **Last Great Religious War Spreads from German Empire into All Europe: 3488.**
    - a. **Gustavus Adolphus, the Protestant Champion: 1553.** Originates modern army 218.
    - b. **Richelieu, French Cardinal and Statesman, Aids Protestant Cause: 3018, 3488.** By this time the religious significance of the War had been forgotten.
  - B. **Results of War:**
    - a. **Religious Question Settled in Germany: 3489.**
    - b. **Political Adjustments: 3489, 1195.**
    - c. **Terrific Devastation of Invaded Countries: 3488–9, 448.**

Struggle for Power and Possessions

- I. THE AGE OF LOUIS XIV IN FRANCE:
  - A. **Louis XIV, "the Grand Monarch": 2065.**
    - a. **Inherits Strong Monarchy Built by Richelieu and Mazarin: 3017, 2065.** Absolutism illustrated by incident of the "Man in the Iron Mask" 1827.
    - b. **Internal Administration under Colbert: 824–5, 1346.** Persecution of the Huguenots 1696.
    - c. **Foreign Policy—Wars to Extend French Power: 2065–6.** Louis did not scruple to use bribery as well as armies to advance his policies; he systematically paid foreign court officials and even rulers to support his cause, as in the case of James II, king of England 1861.
  - B. **French Society during Reign of Louis XIV.**
    - a. **Court at Versailles: 3633.**
      - **1.** Spectacular extravagance: Marriage to Infanta of Spain 3620.
      - **2.** Influence of Madam de Maintenon: 2129.
    - b. **Golden Age of French Literature: 1364–5.** Corneille 891; Molière 2279; Racine 2957; Madame de Sévigné 3181; Voltaire 3660.
- II. STRUGGLE FOR BALANCE OF POWER:
  - A. **What "Balance of Power" Means:** In the 17th century there appears in European politics a new factor, known as the "Balance of Power." Briefly, this meant the maintenance of a balance of equality between the great nations of Europe. In other words, the principle implied that no ruler or country was to be allowed to expand in power so as to overshadow the rest. At this particular period it was Louis XIV who threatened the balance of power.
  - B. **War of the Spanish Succession: 2066, 1156.**
    - a. **Marlborough, the Great English General: 2150.**
    - b. **Results of the Treaty of Utrecht: 3004, 3612, 139, 2763.**
  - C. **War of the Austrian Succession: 2147, 3180.**
  - D. **Seven Years' War: 3180.**
    - a. **Preceded by Diplomatic Revolution:** France and Austria against Prussia and Great Britain: 2147; importance of Chatham 700; weak rule of Louis XV 2066.
    - b. **Overseas Contest:** In America 1362; in India 1753, 573, 796, 382.
    - c. **Results of the War: 3180.** Extension of British Empire 513; losses of France 2066; gains of Prussia 1360–1.
- III. CONSTITUTIONAL MONARCHY ESTABLISHED IN ENGLAND:
  - A. **England Following the Revolution against James II:**
    - a. **Protestant Rule Reëstablished by William and Mary: 3740.** Bill of Rights fixes supremacy of Parliament 393; Toleration Act begins peaceful adjustment of religious rights 2937.
    - b. **Union of Scotland and England: 139, 3149.**
    - c. **Age of Queen Anne: 139.**
      - **1.** Marlborough and the War of the Spanish Succession: 2150.
      - **2.** Period of intellectual activity: 1165; rise of newspapers and periodicals 2474, 1178; Dryden 1043; Pope 2879; Swift 3406; Sir Isaac Newton 2476.
  - B. **Limitation of King's Power under Early Hanoverians:**
    - a. **Growth of Cabinet Government: 1428, 555.** Work of Lord Chatham 700.
    - b. **Whigs Strengthen Position of House of Commons: 2869.**
  - C. **Reaction under George III: 1428, 1430.**
    - a. **Dismissal of Chatham and Close of Seven Years' War: 700, 3180.**
    - b. **Failure of Tory Colonial Policy: 2869, 3338.**
      —Burke, the Champion of Whig Policies toward America: 540.
    - c. **Wars with Revolutionary France and Napoleon: 1368, 1370, 2393–6.**
      - **1.** Work of William Pitt: 2812.
      - **2.** Nelson secures British supremacy of the seas: 2427.
      - **3.** War of 1812 with United States: 3670–3.
      - **4.** Wellington and the battle of Waterloo: 3717, 3699.
- IV. RACE FOR COLONIAL EMPIRES:
  - A. **Results of Discoveries:** It was the inevitable result of the discoveries in the western hemisphere that each European country should hasten to seize as much as possible of the New World. Claims to the new territories were based upon priority of discovery and settlement.

B. SPANISH AMERICA:

a. Columbus Establishes Spanish Claim to New World: 846. Explorations continued by Balboa 305–6; Ponce de Leon 2878; Vespucius 3634; De Soto 999; Coronado 892.

b. Spain Establishes Vast Colonial Empire: South America 3289; West Indies 3718; Central America 680; Mexico 2214; St. Augustine 3106; Santa Fe 2466.

1. Conquest of native peoples: Cortez in Mexico 894–5; Pizarro in Peru 2814.

2. Las Casas work for the Indians: 1965.

c. Spanish Colonial Policy one of Ruthless Exploitation: 3870, 3891–2.

C. Portugal Obtains Great Colony of Brazil: 496.

D. French in North America: 617.

a. Early Explorations: Cartier 651; Champlain 686; Marquette and Joliet 2151, 1900; La Salle 1964.

b. Huguenots Attempt Settlements in South Carolina and Florida: 826.

E. British Exploration and Settlement: 616–7.

a. Early Voyages the Basis of English Claims: The Cabots 561; Drake 1030; Hudson's Explorations 1690.

b. Early Colonizing Enterprises: Raleigh's Lost Colony 2520–1, 2974; Founding of the Thirteen Colonies 3602; Hudson's Bay Company 1692.

Note: For further details of British settlements in North America see Outlines on history of United States and Canada.

F. Other Settlements in North America:

a. Dutch Colonies in New World: 2496–7, 989.

b. Swedes Attempt to Gain Foothold: 989.

G. Colonial Results of the Struggle between England and France: 3180.

a. In America: French and Indian War and French Loss of Canada 1362, 2538.

b. In the Far East:

1. General Situation in the East Indies 1072–3; Ceylon 685; effects of spice trade 3317.

2. French and British in India 1752–3; Clive establishes British rule 795, 3180, 573, 382; Warren Hastings continues Clive's work 1596.

Rise of Prussia and Russia

I. THE BEGINNINGS OF PRUSSIAN POWER:

A. Early Duchy of Prussia under the Hohenzollerns: 2928–9, 1672. Prussia had been converted to Christianity by Teutonic Knights 932, 1195.

B. Frederick the Great Raises Prussia to State of First Rank: 1360.

a. Seizure of Silesia and Seven Years' War: 2147, 3180.

b. Partition of Poland: 2856.

II. FORMATION OF THE RUSSIAN EMPIRE:

A. Russia before Peter the Great: 3089.

a. Early Leadership of Kief: 1922, 3096.

b. Mongol Invasion Shuts off Contact with Western Europe: 2285, 3096–7.

c. Grand Dukes of Moscovy Reorganize Russia: 1853.

B. Peter the Great—How One Man Lashed a Medieval Empire into a Modern State: 2745, 3090.

a. Defeat of Charles XII of Sweden: 698.

b. Baltic Provinces Annexed: 1180, 1969, 2747.

C. Catherine II Continues Peters' Policies: 3090.

a. Seven Years' War: 3180, 2147.

b. Shares in Partition of Poland: 2856; Kosciusko 1944.

c. Ambitions along the Black Sea: 2560.

III. LESSER EUROPEAN STATES IN EIGHTEENTH CENTURY:

A. Decline of Spanish Power: 3304.

B. Italy Without Political Unity: 1836–7. Bourbons succeed Hapsburgs in Naples and Sicily 2391, 3230.

C. Weakness of Austria: After the death of Emperor Charles V, Austria was ruled by the Austrian branch of the Hapsburgs 273, 1578.

a. Lack of Racial Unity: 273.

b. Able Reign of Maria Theresa: 2147, 273. Loss of Silesia 1361; Seven Years' War 3180; partition of Poland 2856, 2147.

French Revolution and Napoleon

I. REVOLUTION IN FRANCE: 1366.

A. Sources of the Revolutionary Movement:

a. Influence of Liberal Thinkers: Voltaire 3661; Rousseau 3070; the Encyclopedists 1367, 1365.

b. Growing Dissatisfaction with the Abuses of the Old Régime: 1366–7, 1352.

c. Failure of Reforms under Louis XVI: 2066, 1367. Influence of Marie Antoinette 2148.

B. Overthrow of the Old Régime:

a. Meeting of the Estates-General: 1367, 1179. Bastile stormed and social revolution 1368; serfdom ended 3249; royal family escorted to Paris 2148.

- **b. Constitution Drawn Up: 1368.** Declaration of the Rights of Man 393, 3778.
- **c. Leaders:** Mirabeau 2259; Lafayette 1956; Talleyrand 3430.
- **d. Flight of King Leads to Abolition of Monarchy: 2067, 1368.** Execution of Louis XVI 2067.

C. Reign of Terror, Government by the Convention: 1370.
- **a. Dominated by Jacobins: 1859.** Robespierre 3027; Danton 961.
- **b. Control Maintained by Terrorism:** Execution of Lavoisier 1249; Madame Roland 3039; Marie Antoinette 2148.

D. Directory Established: 1370.
- **a. Wars with Foreign Powers:** The hostility of France's neighbors to the revolutionary spirit had brought on a whole series of wars 1366, 1368, 2442.
- **b. Napoleon Bonaparte, the "Man of the Hour": 2391.**
  - 1. Early life and education 2391–2; marriage to Josephine Beauharnais 1901.
  - 2. Campaigns under the Directory 2392–3; Egyptian Campaign 2435, 1107.

II. NAPOLEONIC ERA:

A. Bonaparte Overthrows the Directory and Establishes the Consulate: 2393–4.
- **a. Wars against Second Coalition: 2394.**
- **b. Battle of the Baltic: 321; Peace of Amiens: 117.**

B. Napoleonic Empire:
- **a. Imperial Conquests Extended over most of Europe: 2394, 2396.** Naval power crushed at Trafalgar: 2435–6, 1154.
- **b. Napoleon's Work as a Statesman: 2394–6.**
- **c. Effects of Continental System:** In Europe 2396, 85; in United States 1140, 3670, 3671.

C. National Uprisings and Military Reverses Lead to Napoleon's Downfall: 2396.
- **a. Peninsular War 2890, 3717; Retreat from Moscow 2501, 2333.**
- **b. Exile to Elba: 2396.**
- **c. Hundred Days and Waterloo: 2396, 2067, 3699.**

III. CONGRESS OF VIENNA AND PERIOD OF REACTION:

A. Partition of Napoleonic Empire among European powers: 1196, 3642. Talleyrand's work for France: 3430.

B. Formation of Grand and Holy Alliances: 85. The Quadruple (Grand) Alliance was formed by Austria, Russia, Prussia, and Great Britain; the latter subsequently withdrew, and France was included.

Note: In reconstructing Europe the Congress of Vienna was guided by dynastic rather than national claims; the rights of the peoples were entirely ignored. The representatives of the old aristocracy in seeking to restore the "balance of power" sowed the seeds of later conflicts.

C. Age of Metternich:
- **a. Metternich's Influence:** For thirty years after the Congress of Vienna, the moving spirit of European politics was Prince Metternich, the famous Austrian statesman. "As a diplomat, he dictated international policies for a generation; as a statesman, his advice was eagerly sought by the restored princes to whom he became guide, philosopher, and friend." He was "the consistent foe of democracy in every form whatsoever; and the system established by the Congress of Vienna was to him the last word in political wisdom. He set his face like flint against any suggestions of change."
- **b. Metternich's Methods:** Through the Grand Alliance Metternich sought to extend his system by frequent congresses of interested powers and even armed intervention where revolutionary movements seemed serious.
  - 1. In Austria and Germany all liberal movements were successfully smothered.
  - 2. The Carbonari in Italy secretly spread the principles of liberalism: 1837.
  - 3. Extreme reactionary policies of the restored Bourbon king of Spain let to a revolt and civil war which was put down by a French army.
  - 4. The protest of Great Britain and the United States kept the Alliance from interfering in the revolts of the Spanish-American countries 2307.
- **c. Decline of Reactionary Power:**
  - 1. Great Britain joins United States in Monroe Doctrine: 2307
  - 2. Russia supports Greece in War of Independence: 1526.
  - 3. Revolution of 1830 in France overthrows Charles X: 696.

Industrial Revolution

I. **OLD INDUSTRIAL CONDITIONS:** In order to understand the tremendous effects of the Industrial Revolution, it must be remembered that the Renaissance with all its stimulus to intellectual and political thought had had little effect on the every-day life of the people. Nearly all the work of the world was done by hand labor with a few inefficient tools, much as it had been done for centuries 1778; communication was slow and hazardous 3526, 1797; the masses of the people continued to live in the Middle Ages. Then, in about a generation, the adoption of a few practical inventions changed radically most of the conditions of life.

II. HOW THE CHANGE WAS BROUGHT ABOUT:

A. Inventions in Spinning and Weaving: 3326–7.
- **a. Hargreaves' Spinning Jenny: 1589.** Improvements by Arkwright and Crompton 210, 923.
- **b. Cartwright's Power Loom: 652.**
- **c. Whitney's Cotton Gin Adds Impetus to Textile Industry: 3735–6.**

B. Invention of Steam Engine Fills Great Industrial Need: 3348. Watt, father of the steam engine **3704–5.**
C. Rise of the Factory System: 1218.
D. Improvement in Communications:
a. Building of Roads and Canals: 3024, 625–6.
b. Application of Steam Engine to Problems of Transportation: 3210.
1. Fulton's work with the Steamboat: 1381.
2. Locomotives and Railroads: 2962, 2043. Stephenson's Locomotive: 3353.
c. Use of Electricity:
1. Morse invents telegraph: 3454, 2330.
2. Submarine cables unite continents: 558–61.
E. Improvement of Agricultural Methods: 43, 48. Better plows: 2839; reaping machines 2095.

III. SOME RESULTS OF THE INDUSTRIAL REVOLUTION:
A. Economic: 1778.
a. Growth of Cities: 770.
b. Factory System and its Problems: 1218.
1. Medieval Apprentice system ended: 3655.
2. Child labor a social menace: 728–9.
3. Growth of union labor movement: 1947.
B. Influence upon Literature: 1036, 2540.

Europe in the Nineteenth Century

I. DEMOCRACY AND REACTION IN FRANCE:
A. Bourbon Restoration under Louis XVIII: 2067. Reactionary policies of Charles X and the Revolution of 1830: 696.
B. Louis Philippe, the Citizen King: 2067.
C. Revolution of 1848 and Second Republic: 1353, 2397.
D. Napoleon III and the Second Empire: 2397.
a. Foreign Policy: Participates in Crimean War 922, 3560; aids Italy against Austria 670, 1837, 3638; interferes in Mexico 1898, 2216.
b. Domestic Administration Marked by Prosperity and Public Improvements: Paris rebuilt 2685.
E. Franco-Prussian War and the Third Republic:
a. Germany Crushes France in Franco-Prussian War: 1355, 1448–9. Siege of Metz 2207; disaster at Sedan 3171, 2397.
b. Third Republic: 1353. Commune of Paris suppressed: 1356, 2685.

II. FOUNDING OF THE GERMAN EMPIRE:
A. Revolution of 1848 Seeks Democratic and United Government: 1448, 2929. Political refugees after failure of revolution began great German immigration to United States 3737, 3772, 1357.
B. Bismarck Builds up Prussia's Power: 427, 2929, 1448. Schleswig-Holstein seized 994, 997; Seven Weeks' War with Austria and formation of North German Confederation 1448.
C. Franco-Prussian War and Empire Proclaimed:
a. Germany Defeats France in Short Campaign: 1355, 427–8.
b. Germany United as a Hohenzollern Empire: 1449, 3633, 3737–8.

III. FORMATION OF AUSTRIA-HUNGARY:
A. Revolution of 1848 in Hapsburg Lands:
a. Kossuth and Hungarian Republic: 1945, 1703.
b. Insurrection in Italy Led by Sardinia-Piedmont: 1837.
c. Revolt in Bohemia: 447.
B. Francis Joseph Begins Long Reign: 1354.
a. Loss of Italian Provinces: 1837, 670, 1399, 3638.
b. Defeated by Prussia in Seven Weeks' War: 1448, 428.
C. Dual Monarchy Formed: 1703, 273.

IV. UNIFICATION OF ITALY: **1837–8.**
A. Mazzini and the Republic of Rome: 2178.
B. Sardinian Leadership under Victor Emmanuel and His Great Minister, Cavour: 3638, 670.
a. Garibaldi and His "Thousand Red-Shirts": 1399.
b. Why the Pope Opposed the New Kingdom: 2813–4.

V. GREAT BRITAIN IN THE NINETEENTH CENTURY:
A. Beginnings of Political and Social Reforms:
a. Industrial Revolution Brings Demand for More Democratic Government and Remedy of Social Abuses: 1778, 1154–5.
b. Catholic Emancipation Act: 2559, 2706. The laws prohibiting "Dissenters" from holding office had already been repealed; in 1858 political privileges were extended to the Jews.
c. Parliamentary Reform Act of 1832 Transfers Political Power to Middle Classes: 2688, 3083, 2869.
d. Factory Laws: 1218, 729; Poor Relief: 2878.
e. Repeal of Corn Laws and Establishing of Free Trade: 1155, 2706, 2869.

- B. Victorian Age:
  - a. **Influence of Queen Victoria: 3639.**
  - b. **Reflected in Literature: 1167.**
- C. Victorian Foreign Policies:
  - a. **Crimean War and the Integrity of Turkey: 3560, 922, 3084.**
  - b. **Attitude towards the American Civil War: 12, 781, 3084, 1468.** Arbitration of Alabama Claims: 73.
- D. Continuation of Reform Movement:
  - a. **Political Reforms:** Suffrage extended 2688; women's suffrage 3779; adoption of secret method of voting 321, 1468; veto power of the House of Lords restricted: 2688, 2040.
  - b. **Social Reforms:** Employers' liability act 1145; old age pensions 2722; trade unions given legal status 1947; Lloyd George's land reform and social legislation 2040.
  - c. **Religious Reform:** Disestablishment of the Irish Church 1468, 1811; religious qualifications removed from Universities 1468; Welsh Church disestablished 3665.
  - d. **The Irish Question: 1811.** Gladstone's attempt to solve it 1468–9; work of Parnell 2689–90, 476.
- E. Growth of the Empire: **513–4, 837.**
  - a. **Disraeli Lays Foundation for Modern British Imperialism: 1013.** Control of Suez Canal 3384.
  - b. **British Public "Discovers" India in Sepoy Rebellion: 1753–4.** Victoria crowned Empress 3640.

VI. OTHER EUROPEAN COUNTRIES IN NINETEENTH CENTURY:

- A. Scandinavian Countries:
  - a. **Denmark:** Loses Norway after Napoleonic Wars 997, 2536; Prussia and Austria seize Schleswig-Holstein: 428, 757.
  - b. **Sweden: 3404–5.** Loss of Finland 1248; loss of Norway 2536.
  - c. **Norway becomes an Independent Kingdom: 2536.**
- B. Iberian Peninsula:
  - a. **Spain Loses Most of Colonial Empire: 3304, 3306.** See also articles on Mexico, Central America, and South American countries for details of the colonial revolutions.
    - 1. Insurrections in Cuba and War with United States: 938, 3306–7.
    - 2. Alfonso XIII begins task of modernizing country: 90.
  - b. **Portugal: 2890–1.** Revolution of 1910: 2026.
- C. Belgium and Holland:
  - a. **Belgium Revolts from Netherlands: 2442, 1196, 520.**
  - b. **Kingdom of Belgium: 376.** Scheldt River controversy 3136; Leopold II secures Congo region: 40, 859.

Awakening of the Far East

I. EUROPEANS IN CHINA:

- A. **China Opened to Foreigners through Treaty Ports: 746, 3498.** Great Britain obtains Hongkong through Opium War 1679, 2585.
- B. **Exploitation by Foreign Powers: 748.**
  - a. **Defeat by Japan Leads to Foreign Intervention: 1869–70.**
  - b. **German Holdings in Shantung: 3195.**
  - c. **Manchuria Falls under Russian and Later under Japanese Influence: 3098, 2134.**
  - d. **"Open Door" Agreement Saves National Integrity: 3606.**
- C. **Revolution Establishes Republican Government: 746.**

II. RUSSIA TURNS TO THE EAST:

- A. **Reaction in Russia after the Crimean War: 3090–2.**
  - a. **Alexander, the "Czar Liberator," Frees the Serfs: 85.**
  - b. **Return of Tyrannical Policies: 85, 2506.**
    - 1. Influences of Nihilist Movement: 3097.
    - 2. Tolstoy, the voice of Russia: 3512.
- B. Advance in Asia:
  - a. March to the Pacific:
    - 1. Trans-Siberian Railroad links Petrograd with the Pacific: 3228, 233.
    - 2. Port Arthur appropriated: 1870.
    - 3. Influence extended through Manchuria: 3098.
  - b. Central Asia:
    - 1. Conquest of Trans-Caucasia and Turkestan: 664, 3555–6.
    - 2. Pressure on Indian-Border—buffer state of Afghanistan: 31.

III. TRANSFORMATION OF JAPAN:

- A. **Country opened to Foreigners: 1862, 3830.**
  - a. **Perry's Expedition: 1240.**
  - b. **Earlier Contact with Westerners: 1869, 3823.**
- B. **War with China, the Test of the New-found Power: 1869–70.** Chinese attitude toward Japan 748.
- C. **Russo-Japanese War Makes Japan a World Power: 3098.**
  - a. **Growth of Japanese Influence in Manchuria: 2135, 1870.**
  - b. **Annexation of Korea: 1943, 1944.**

Europe Before the World War

I. ARMED PEACE IN EUROPE:

A. **Triple Alliance between Germany, Austria, and Italy: 1196, 3529, 3795.** A serious weakness of this alliance lay in the fact that Italy was linked with her ancient enemy, Austria, who still held Italian territories ("Unredeemed Italy"); Italy had joined the alliance from pique at France for seizing the coveted Tunis and fear of her interference in behalf of the Pope. That the Alliance was unstable was well proved in the opening years of the World War.

B. **Triple Entente of France, Russia, and Great Britain: 1195, 3529.** Originally a Dual Alliance of Russia and France, it was enlarged to include Great Britain during Edward VII's reign 1089.

Note: These Alliances were based on the old principle of the "Balance of Power." France and Russia were balanced against Germany and Austria. Italy joined the latter because of the north African quarrel, while Great Britain, fearing the growing sea-power of Germany, threw its weight on the side of France and Russia.

C. **Germany's Industrial Growth and Need for New Markets. 3905, 1444.**
  - a. **William II Backs Economic Ambitions with Militarism: 3738.**
  - b. **Effect of Struggle for Colonial Possessions: 837.**

D. **Hague Peace Conference, an Attempt to Combat Militarism: 1559, 2506.**

II. THE NEAR EAST AND THE DISMEMBERMENT OF TURKEY:

A. **Russia Reaches Down Toward the Mediterranean: 3559–60.**
  - a. **Crimean War: 922.**
  - b. **Russo-Turkish War: 310, 1013.**

  Note: The Western Powers rushed to the aid of Turkey not from sympathy with its cause, but to prevent Russia from securing any considerable influence in Constantinople and the Dardanelles.

B. **Balkan Wars Deprive Turkey of Most of Its European Territory: 310, 3560:** Territorial gains of Greece 1526; Serbia 3176; Montenegro 2313; Rumania 3080.

C. **Central Powers Look Toward the Near East:**
  - a. **Germany's Balkan Policy and the Bagdad Railroad: 310, 304, 233, 2201.**
  - b. **Austria: 310, 3177.** Annexation of Bosnia-Herzegovina: 468, 1196.

III. SCRAMBLE FOR AFRICA:

A. **Modern Explorations Disclose Vast Resources: 38.** Livingstone and Stanley 2033, 3338; Leopold II of Belgium starts the race for Africa 859.

B. **Partition of Africa at Congress of Berlin: 40.**

C. **British Empire in Africa: 513.**
  - a. **Occupation of Egypt: 1097.** Control of Suez Canal 3384, 1013; conquest of Anglo-Egyptian Sudan 1093, 1095 (map); "Chinese" Gordon and Kitchener 1489, 1929.
  - b. **British Obtain Control of South Africa: 3280–2.** Boer War 446; Cecil Rhodes 3011.

D. **Extension of French Influence:**
  - a. **The French in Algeria and Tunis before Congress of Berlin: 97, 3550.**
  - b. **Germany Challenges French Rights in Morocco: 2327.**

E. **Italy Obtains Tripoli in War with Turkey: 3541, 1196.**

World War and Its Consequences

I. CAUSES:

A. **The Spirit of Aggression:** The fundamental cause of the great catastrophe was the aggressive nationalism which had been steadily growing in the great European states. International relations were regarded as essentially competitive and it was only in rare instances, as the International Postal Union (2898), that true coöperation had obtained. As we have seen, in the half century of diplomacy before 1914, national ambitions found an outlet in imperialistic colonial enterprises and a military rivalry that turned Europe into an armed camp.

B. **The Spark that Started the Blaze:** The immediate cause was the crisis raised by the assassination of the heir to the Austrian throne: 3789–90. 1196, 1354, 310.

II. MILITARY EVENTS OF THE WAR:

A. **The Western Front:**
  - a. **Germany's Plan to Reach Paris by Striking through Belgium: 3791–2.**
    1. Delay in Belgium and fall of Liége: 1995, 81.
    2. Plan shattered at the Marne by French under Joffre: 2150–1, 1894–5.
    3. Germans "dig in" along the Aisne: 69.
  - b. **Dash for Channel Ports to Cut off British Checked at Ypres: 3833–4, 3792, 571.** Fall of Antwerp 153.
  - c. **Deadlock of Armies:** For eighteen months the lines remained practically deadlocked; neither side could break through the entrenchments of the enemy 3792.
  - d. **Campaigns in 1916: 3794.** French hold position at Verdun 3629; battles along the Somme 3275.
  - e. **Events of 1917: 3797.** Germans establish the "Hindenburg Line" 1650-1; lose Vimy Ridge 220.
  - f. **United States Enters the War: 3800–4.**
  - g. **The Supreme Struggle of 1918: 3904–6.**
    1. Reënforced by troops released in the East, the Germans launch offensive along the Somme towards Amiens: 3275, 117, 220.

consult the Easy Reference Fact-Index at the end of this work

    2. German advance along the Aisne 69; Cantigny, Château-Thierry, Belleau Woods 638, 699, 380.
    3. Allied forces united under Foch 1315; steady gains along the Marne 2151; Saint-Mihiel 3110; Meuse-Argonne victories 193–4, 2207; triumph at Sedan 3171.
  h. Armistice Halts Further Advances: 3806, 3808, 213–4.
- B. Other Campaigns:
  - **a. Russian Front: 3794.**
    1. Russians driven out of East Prussia and Poland by brilliant strategy of Hindenburg and Ludendorff 1650, 2076; Warsaw captured 3673.
    2. Revolutionary Government makes peace with Germany: 3798, 3094–6.
  - b. War in the Balkans:
    1. Serbia and Montenegro crushed by Central Powers: 3794–5, 3806–7, 2313, 377.
    2. Rumania overwhelmed: 3795, 3080, 523.
    3. Saloniki Campaign: 2097.
  - **c. Failure at Dardanelles a Blow to Allied Prestige: 3795, 963.**
  - **d. Italian Campaign: 3795, 3797–8, 3807, 3539.**
  - **e. Events in Near East:** In Mesopotamia 3795–6, 3798, 305; In Syria 3798, 3807, 2643, 166.
  - **f. War in South and East Africa: 3796, 1068, 1069.** Work of Boer Generals Botha and Smuts 475, 3254.
  - **g. Japan Captures German Territory of Kiaochow: 1870.**
  - **h. Australian Expedition to New Guinea: 2453.**

III. NAVAL OPERATIONS:

- **A. Allies Control the Surface of the Seas: 3796.**
  - **a. German Ships Captured or Sunk: 1223, 2423.**
  - **b. Battle of Jutland Confirms Allied Power: 2423, 356.**
  - **c. Blockade of the Central Powers: 437, 1140.**
- **B. German Submarine Campaign, an Attempt to Break the Blockade: 3376–8, 3791.**
  - **a. Attacks on Neutral Commerce: 3799, 3746–7.**
  - **b. Allied Defensive Measures:** North Sea Mine Barrage 3518–20, 2528, 2601; Raid on Zeebrugge 520.

IV. HOW THE WAR WAS FOUGHT:

- **A. New Development in Military Science: 3790–1.**
  - **a. Abandonment of Open Field Operations for Trench Warfare:**
    1. Long-range guns render strongest fortresses useless: 633–5, 636.
    2. The effect of machine guns: 2097–2101.
    3. Poison gas 1408; star shells 1266; use of autos 274–5.
    4. Tanks meet new needs of trench fighting: 3433.
  - **b. Importance of Airplanes: 58–60.**
- B. Organizing Citizen Armies:
  - **a. British War Machine: 3792, 3794.**
    1. Lloyd George and the Coalition Government: 2040–1.
    2. Training of "Kitchener's Mob": 1930.
    3. Leaders: Haig 1559; Beatty 355–6.
  - **b. Canada's Part: 620.** Sir Robert Borden 466; Sir Sam Hughes 1693; General Currie 940.
  - **c. The Part of Australia 269; India 1754; South Africa 3796, 3254, 475.**
  - **d. How the United States Mobilized: 3801–4, 3748.**
    1. Military leaders: March 2145; Pershing 2732–3; Sims 3243.
    2. Establishing the A. E. F. in France: 466, 502, 3110.
    3. Civilian Activities: Food Conservation 1680, shipbuilding 3214, 3216, 3218; Red Cross 2984–6.
- C. Devastation and Relief Works:
  - **a. Belgium and Northern France: 376, 1353.**
    1. Cities looted and destroyed: Antwerp 152–3; Bruges 520; Liége 1995; Lille 2008; Louvain 2073; Reims 2992–3; Saint-Quentin 3111.
    2. Relief Work: Cardinal Mercier 2199; King Albert 81; Hoover and his work 1679.
  - **b. Suffering in Other Lands:** In Poland 2858; massacres in Armenia 213; looting of Rumania 3080.

V. DIPLOMATIC RELATIONS IN THE WORLD WAR:

- **A. Allies Joined by Montenegro 2313; Japan 1870; Italy 3795: Portugal 2890; Rumania 3795, 3080.**
- **B. Central Powers Strengthened by Turkey 3560; Bulgaria 533.**
- **C. United States Drawn into the Conflict: 3798–3801, 3746–7.** Followed by Brazil 496; China 748; Greece under Venizelos 3625, 1526.
- D. Overtures of Peace:
  - **a. Pius X Appeals for Peace at Beginning of War: 2814.**
  - **b. Wilson Offers Mediation for "Peace without Victory": 3747.**
  - **c. Benedict XV Suggests Terms to the Belligerents: 382**
  - **d. Central Powers Force Peace upon Rumania: 3080.**
  - **e. Revolutionary Russia Signs Treaty of Brest-Litovsk: 3798, 3575.**

VI. PEACE CONFERENCE AT PARIS:

- **A. Attended by Representatives from All Allied and Associated Powers: 3633, 3808.**
  - **a. Dominated by "Big Four":** Wilson 3748; Lloyd George 2041; Clemenceau 787; Orlando 3808.
  - **b. Other Influential Delegates:** Borden 467; Smuts 3254; Venizelos 3626.

B. **Treaty of Versailles with Germany: 3808, 3811, 3749, 1196.** Subsidiary Treaties with Austria (St. Germain) 3811–2; Hungary (Trianon) 1703–4; Bulgaria (Neuilly) 533, 3812; Turkey (Sèvres) 3812, 3560.

Note: For details concerning the political and territorial changes made by these treaties, see the section on "Results and Peace Settlement" under the World War entry in the Fact-Index.

C. **League of Nations Established: 1974, 3808.**

D. **American Senate Refuses to Ratify the Treaty without Reservations: 3812, 3749.** Separate treaty signed with Austria and Germany: 1582.

Note: The United States was not alone in refusing to ratify the treaties signed at the Peace Conference; China refused to sanction the loss of Shantung (3812), and other treaties were disregarded. This situation led to a series of international conflicts and the subsequent modification of much of the work of the Conference (3812).

VII. REVOLUTIONS AND THE NEW NATIONS OF EUROPE:
A. Russian Revolution: **3092, 3094–6.**
a. **Abdication of Nicholas II: 2506.**
b. **The Bolshevists and Their Leaders Lenin and Trotzky: 450, 1986, 3544.**
c. **Disruption of the Empire: 3084.** Loss of Finland 1248; Loss of Esthonia 1180; Latvia 1969; Lithuania 2030; Russian Poland 2856; Bessarabia 3080; Siberia 3229; Ukraine 3575, 2560. See also in Geography Outline pages 3914, 3921.
B. Dissolution of Austria-Hungary and the Formation of New States:
a. **Czecho-Slovakia Obtains Independence: 947, 447.**
b. **Slavs of Austria-Hungary Join Serbia and Montenegro to form Jugo-Slavia: 1901, 468.**
c. **Austria Stripped of Former Possessions, 269, 3642.**
d. **Hungary Given Independence: 1703, 524.**
C. Hohenzollerns Overthrown in Germany: **3808.**
a. **William II Seeks Refuge in Holland: 3738.**
b. **Republican Government Established Throughout German Empire: 1444–5, 2929, 347, 3132.**

UNITED STATES HISTORY

I. PERIOD OF DISCOVERY AND EXPLORATION:
A. The Men who Found the New World:
a. **Leif Ericsson the Northman: 2526, 2527.**
b. **Christopher Columbus and His Achievement: 846.**
B. Explorations and Explorers:
a. **Of the Atlantic Coast:**
1. John Cabot visits North America: 561.
2. Cartier explores the St. Lawrence: 651.
3. Hudson discovers Hudson River and Hudson Bay: 1690.
4. Captain John Smith maps northern coast: 3253.
b. **Spanish in the South:**
1. Ponce de Leon in Florida: 2878.
2. De Soto discovers the Mississippi: 999.
3. Coronado's search for the mythical cities: 892.
c. **French in the Interior of North America: 2265** Champlain 686; Marquette and Joliet 2151, 1900; La Salle 1964; Hennepin 1632.

II. UNDER COLONIAL RULE:
A. Founding of the Thirteen English Colonies:
a. **Virginia Settled at Jamestown: 1861, 3252–3.** Bacon's Rebellion: 301.
b. **New York Settled by the Dutch: 2496–7, 80, 2486.** Captured by the British 2497, 3375.
c. **Massachusetts Colony:**
1. Plymouth Colony founded: 2175–8, 2841–2, 3338.
2. Puritan Migration and Massachusetts Bay Colony: 2170, 3757, 472, 2937; includes Maine 2129.
3. Witchcraft persecutions: 3774.
d. **Dutch and Swedes Settle along the Delaware: 989.**
e. **Maryland Founded: 2163, 139.** Baltimore 322
f. **Early Connecticut: 867–9, 1595.** New Haven founded 2456.
g. **Roger Williams Founds Rhode Island: 3742, 3008-10, 2927.**
h. **New Jersey under Different Flags: 2461.**
i. **The Carolinas: 2520–1, 3292, 699.**
j. **New Hampshire becomes a Separate Colony: 2456.**
k. **Quaker Colony of William Penn: 2716, 2721–2.**
l. **Georgia, the Last of the Thirteen Colonies: 1434, 3130.**
B. French and Spanish Settlements:
a. **French Posts in the Upper Mississippi Valley and the Great Lakes Region: 617.** Detroit 2226, 999; St. Louis 3110; in Illinois 1736; Indiana 1762; Wisconsin 3772.
b. **French in the Lower Mississippi Valley: 2072.** New Orleans 2471.
c. **Spanish Cities of St. Augustine, Santa Fe, and Albuquerque: 3106, 2466.**

C. Beginnings of Democracy in the Thirteen Colonies:

a. Political Foundations:

1. The meeting of the Virginia House of Burgesses in 1619 was the first legislative assembly held in America.

2. Mayflower Compact, the first written agreement establishing a government by the governed: 2176.

3. Direct democratic government in the towns: 3521, 3008–9. The most liberal of the colonial charters based suffrage upon a property qualification 3009; voting was in most cases by acclamation 321.

4. In the South the county was the local government unit: 3521.

5. Connecticut frames the first written constitution: 868.

b. Liberty in Matters of Religion:

1. Rhode Island was the first colony to grant religious freedom: 3742.

2. Maryland soon followed: 2163; gradually the restrictions were removed in other colonies.

D. French and Indian War Ends the Struggle for the Mississippi Region: 1362, 3180–1.

a. Attitude of the Indians: 1772, 2486.

b. Braddock's Defeat: 3676.

c. Capture of Louisburg: 2538.

d. Montcalm and Wolfe at Quebec: 2312, 3775, 2949.

E. Movements Toward Unity: 3592, 3602.

a. New England Confederation Formed against the Indians: 3757. Indian uprisings against the colonists 1772, 3332.

b. Albany Congress and Franklin's Plan of Union: 80.

c. Stamp Act Congress: 3337, 2604.

d. Obstacles to Unity: Lack of good communications and differences in the social and economic life of the northern and southern colonies.

Note: For details concerning the general social conditions in the colonies, consult the "Colonial Period" section under "United States History" in the Fact-Index.

III. REVOLUTIONARY WAR:

A. Causes of the War: 3000–2.

a. British Policy which Roused Colonists' Ire:

1. Tories support George III's attempt to exercise "Divine Right of Kings": 2869, 1428, 1430.

2. Opposed by Whig Party under leadership of Chatham and Burke: 2869, 700, 540.

b. The Effect of the Stamp Act: 3337–8. Stamp Act Congress: 3592.

c. First Continental Congress Protests against Coercive Acts: 3593.

d. Colonial Leaders Opposed to Crown Policies: Samuel Adams 16; Patrick Henry 1637; James Otis 2604 John Hancock 1570.

e. Many Loyalists Support the Royalist Cause: 617, 2583.

B. Beginnings of Open Warfare:

a. Lexington and Concord: 1990. Paul Revere's famous ride 2999–3000.

b. Battle of Bunker Hill: 533–4. Israel Putnam, the American Cincinnatus 2939.

C. Independence Declared: 975–6, 3002–3.

a. Paine's Appeal for Independence: 2626.

b. Work of Richard Lee 1982; John Adams 13.

D. Military Events of the War:

a. George Washington, Commander-in-chief of the Colonial Forces: 3676.

b. Battle of Saratoga, the Turning Point of the War: 3003, 3126, 1408.

c. Winter at Valley Forge, the Low Ebb for Washington's Army: 3615, 3003. Baron Steuben trains the troops: 3355.

d. George Rogers Clark Wins the Old Northwest for the Colonies: 783.

e. Exploits of Famous Men: Ethan Allen 98; Horatio Gates 1408–9; Nathanael Greene 1539; Nathan Hale 1565; Francis Marion 2149; Anthony Wayne 3706–7; John Paul Jones 1900–1. The tragedy of Arnold 219, 123.

f. Gallant Foreigners who Aided the Colonists: DeKalb 987; Kosciusko 1944; Lafayette 1956; Pulaski 2933; Rochambeau 3033; Steuben 3355.

E. French Treaty of Alliance: 3003, 1956, 1367. Franklin's work at the French Court 1358.

F. Government During the War:

a. Second Continental Congress: 3593.

b. Finances Managed by Robert Morris: 2328.

G. Treaty of Peace: 3004, 3602, 3633. Negotiated by Franklin 1358, Adams 13, and Jay 1880.

IV. CRITICAL PERIOD OF AMERICAN HISTORY: 3602.

A. Government under the Articles of Confederation:

a. Weakness of the Government: 3593, 3347.

1. The Articles of Confederation "established not so much a form of government as a method of diplomatic intercourse."

2. Unsettled political and financial conditions cause unrest; Shays' Rebellion 3197.

b. Northwest Territory Organized: 2528–9, 1882.

- **B. Formation of the Constitution: 3593–4.**
  - **a. Personnel of the Constitutional Convention: 3593.** Influence of Washington 3677; Madison, the "Father of the Constitution" 2107.
  - **b. Form of Government Provided by the New Constitution: 3593, 3595.**
    - **1.** Legislative Department: 860–2.
    - **2.** Executive Department—President and Vice-president: 2913–4, 3636–7.
    - **3.** Judiciary: 909.

  Note: For details regarding the provisions and interpretation of the Constitution consult the entry "United States Constitution" in the Fact-Index.
  - **c. Fight over Ratification:**
    - **1.** Campaign for adoption led by Hamilton, Jay, and Madison through "The Federalist": 1568, 1880, 2107. Importance of Hancock in Massachusetts 1571; Marshall in Virginia 2155.
    - **2.** Opposed by Patrick Henry, Lee, and Monroe in Virginia: 1638, 1982, 2306; by Samuel Adams in Massachusetts: 16.
    - **3.** Adoption of first ten amendments removes much objection: 3594, 393, 2918.

V. NATIONAL BEGINNINGS:

- **A. Period of Federalist Influence: 3602, 3604.**
  - **a. Organization of Federal Government under Washington's Guidance: 3677–8.** How the Cabinet came into existence: 555.
  - **b. Sound Financial Policy Initiated by Hamilton: 3677, 1569.**
  - **c. Rise of Opposing Political Parties—Federalists and Democratic Republicans: 3677, 2870.** Led by Jefferson and Hamilton: 1882.
  - **d. Jay Treaty Adjusts Difficulties with Great Britain: 1880, 2227.**
  - **e. Adams' Administration and Downfall of the Federalist Party: 13–14.**
    - **1.** X Y Z Affair with France: 3826.
    - **2.** Alien and Sedition Laws passed by Federalists rouse much opposition: 3347, 14.
    - **3.** Appointment of John Marshall to Supreme Court—importance in development of Federal Government: 2155.
- **B. Triumph of Democratic Republicans:**
  - **a. Election of Jefferson to Presidency: 1882–3.** Twelfth Amendment enacted to prevent repetition of contest in Congress 3637.
  - **b. Jeffersonian Ideas of Democracy: 1883, 3604.**
  - **c. Louisiana Purchase Opens up Vast Possibilities of Expansion: 2072–3.** Lewis and Clark 1989.
  - **d. Harrison and the Indians in the Northwest: 1594, 3451–2.**
- **C. War of 1812: 3670, 3604, 2108.**
  - **a. Causes of the War 3570–1.**
    - **1.** Disputes with Great Britain and France over neutral trade lead to Embargo Acts: 1883, 1140.
    - **2.** "War Hawks" demand war with Great Britain: 3671, 785, 575.
  - **b. Brilliant Naval Duels: 3672, 2423.** Decatur 971; Lawrence 1972–3; Perry 2730.
  - **c. Land Campaigns: 3672.** Harrison in the Northwest 1594; Jackson in the South 1856, 73.
  - **d. Opposition in New England: 3672–3, 3347, 3604, 2108, 521.**
  - **e. Growth of a National Spirit: 3673, 3604.**
- **D The Period of Transition from 1815 to 1829.**
  - **a. New Social and Economic Conditions:** The War of 1812 was followed by a readjustment of interests throughout the country. Under the guidance of John Marshall the national character of the government was strengthened by a broad construction of the Constitution 2155. With the decline of the ship trade in New England, commercial fortunes were devoted to manufacturing 3007, 3008; mill towns sprang up along the rivers 2075, 1973, 2449; agitation began for a tariff to protect the new industries. The invention of the cotton gin opened a new era in the South 3735-6; large scale production of cotton became profitable; with it came a revival of slave labor and the spread of the plantation system. At the same time the South became increasingly dependent upon imported manufactured goods, and therefore favored low tariffs 575, 776. To the West the problem of transportation was all-important, for its prosperity depended upon the construction of roads and canals for shipping its grain and live stock 627, 3024; here the demand for cheap tools and cloth was tempered by the desire for the protection of agricultural produce. From these mixed motives Clay evolved his famous "American System" which was to protect the Eastern manufacturers and supply funds for extensive internal improvements 785.
  - **b. Era of Good Feeling: 2306–7.**
    - **1.** Missouri Compromise, the first national crisis on the slavery issue: 2273, 786.
    - **2.** Expansion of territory, Florida purchased: 1295.
    - **3.** Monroe Doctrine formulated—the basis of American foreign policy: 2307, 2305.
  - **c. Administration of John Quincy Adams: 15.** Beginnings of Whig and Democratic Parties. 2870; the tariff question 575.
- **E. Jacksonian Epoch and Western Expansion: 3604, 1856.**
  - **a. Jackson and the Nullification Principle:** Rise of the nullification theory 3347–8; Webster-Hayne Debate 3710; Tariff of Abominations nullified by South Carolina 3348, 575; Force Bill and Compromise Tariff 1857, 3711, 786.

- b. **Financial Policy and War upon National Bank: 1856–7.** Continued by Van Buren 3616.
- c. **Indian Affairs:** Trouble over Indian removals from Georgia 1857; Seminole War in Florida 3617, 1773; tribes settled in "Indian Territory" 2576.

F. Rounding Out National Boundaries: **3604, 3605** (map).

- a. **Texas Annexed: 3571, 2872.** Houston and Austin help Texas secure independence 3478, 261, 1688; David Crockett 922.
- b. **Oregon Country Acquired: 2872.**
- c. **Southwestern Territory Ceded by Mexico: 2208.**
- d. **Gadsden Purchase: 2802.**

G. Foreign Relations:

- a. **Webster-Ashburton Treaty Settles Northeast Boundary Dispute: 3571, 2129.**
- b. **Northwestern Boundary Question Settled by Treaty: 2872.**
- c. **War with Mexico: 2207, 2872.**
  - **1.** Services of Generals Scott and Taylor: 3153, 3444.
  - **2.** Americans seize California: 580–1.
- d. **Clayton-Bulwer Treaty Regarding Proposed Isthmian Canal: 3444, 2653.**

H. New Social Conditions:

- a. **New Era in American Political Methods Ushered in by "Log Cabin" Campaign: 1594.**
  - **1.** Jackson had already introduced the "Hero on Horseback" and shown what a powerful party influence the Spoils System could be: 1856.
  - **2.** It was at this time that the convention system became established: 2870.
- b. **Influx of Foreign Immigrants: 1738, 1810, 3771, 3772, 766.** Opposition of Know-Nothings: 2871.
- c. **Rapid Development of Western Prairies Due to Improved Farm Machinery and Transportation: 44, 2095.**
  - **1.** Steamboating on the Ohio and Mississippi: 2268.
  - **2.** The thirty years preceding the Civil War saw a tremendous activity in railroad building. Beginning in 1830 with a few miles of track, 2302 miles had been built by 1840. In the next decade 5043 more miles were added and, largely owing to the government land grant policy (1960), 21,424 miles were in existence in the fifties: 1960.
  - **3.** Gold Rush to California hastens development of West: 581, 582, 650.
- d. **Moral and Intellectual Movements:**
  - **1.** Golden Age of American Literature: 112–4.
  - **2.** Temperance and Prohibition Movements gain strength: 3465, 2920.
  - **3.** Beginning of the movement for women's rights: 3778.

VI. SLAVERY BECOMES THE GREAT ISSUE:

A. Rise of the Abolition Movement: **473, 2572, 3391–2.**

- a. **William Lloyd Garrison Founds the 'Liberator': 1400–1.**
- b. **Anti-Slavery Movement in Congress:** Adams' fight against "gag rule" 15–16; Benton's stand 383; Seward 3182; Sumner 3391.
- c. **Literature of the Movement: 112–3, 3249.** Whittier 3736; Greeley 1538; 'Uncle Tom's Cabin' 3368.

B. Southern Desire for More Slave Territory: **2802, 855.** Calhoun's position 576.

C. Rapid Territorial Expansion Makes Question Acute: **2872, 855.**

- a. **Annexation of Texas: 3571.**
- b. **Oregon Territory Secured: 2598, 3688.**
- c. **Cessions of Mexico after Mexican War: 2207, 2208.**

D. The Approach of the Crisis:

- a. **Compromise of 1850: 855–6, 1240.**
- b. **Kansas-Nebraska Bill and Struggle for Kansas: 1913.** Douglas' Doctrine of Squatter Sovereignty 1027, 2017.
- c. **Republican Party Founded on Anti-Slavery Principles: 2870, 3772, 2012, 435.**
- d. **Dred Scott Decision: 1039, 522.** Lemmon Case in New York 222.
- e. **Lincoln-Douglas Debates: 2017, 1027.**
- f. **John Brown's Raid: 516.**

E. Election of Lincoln to Presidency: **2012, 3182, 435.** Early life and political career: 2011–12.

VII. THE CIVIL WAR: 776.

A. Preliminary Events:

- a. **The Secession Movement:**
  - **1.** Growth of States' Rights and Secessionist doctrines: 3347–8.
  - **2.** South Carolina and six other states secede and form a Confederacy: 857, 777.
  - **3.** Weakness of Buchanan's position: 522–3.
- b. **Fall of Fort Sumter and Lincoln's Call for Troops: 1332, 2014, 777–8.**
- c. **Indecision of the Border States:** Maryland 2164, 322; Kentucky 1920; Missouri 2273; separation of West Virginia 3723.

B. Comparative Resources of North and South: **778.**

- a. **Northern Leaders:** Lincoln 2014, Seward 3182, and Stanton 3339 in the administration: Grant in the field 1498; Adams abroad 12.

- **b. Southern Leaders:** Lee and Stonewall Jackson 1982, 1858; Jefferson Davis and Alexander H. Stephens 967, 3353.

- **C. Progress of the War:**
  - **a. Opening Events:**
    - **1.** Battle of Bull Run: 533, 778.
    - **2.** Trent Affair with Great Britain: 3539.
  - **b. Campaign of 1862 in the West:**
    - **1.** Opening of the Upper Mississippi—Forts Henry and Donelson 1498, 779; Shiloh 3206–7, 3205, 1498.
    - **2.** Opening of the Lower Mississippi—New Orleans: 1225, 2884.
  - **c. Campaign of 1862 in the East:**
    - **1.** McClellan and the Peninsular Campaign: 2095, 778.
    - **2.** Lee's attempts to carry war into North: Antietam 149–50; Fredericksburg 1361, 1571.
  - **d. Emancipation Proclamation: 1139–40, 778, 2014.**
  - **e. The Crisis of 1863:**
    - **1.** Lee's second failure to carry the campaign North: Chancellorsville 687, 1858; Gettysburg 1453, 2179, 1571.
    - **2.** Fall of Vicksburg opens all of the Mississippi: 3637, 2884.
    - **3.** Control of Eastern Tennessee: battles of Chickamauga 3490, 700; Chattanooga 700–1, 1498.
  - **f. Naval War:**
    - **1.** Southern ports blockaded: 437, 968; effect in England 12.
    - **2.** Fight between the 'Monitor' and the 'Merrimac': 2286.
    - **3.** Career of the 'Alabama': 73, 12.
    - **4.** Farragut captures Mobile Bay: 1225.
  - **g. The Campaign of 1864.**
    - **1.** Grant's operations against Richmond: 1984, 1498, 3019.
    - **2.** Sheridan in the Shenandoah Valley: 3204–5.
    - **3.** Sherman's march to the sea: 254, 3205–6.
    - **4.** Thomas defeats Hood in the west: 3490, 2398.
  - **h. Surrender at Appomattox: 1498–9, 1984, 779, 781** (picture).

VIII. RECONSTRUCTION PERIOD: 3605.

- **A. Problems of Reconstruction: 780.**
  - **a. Quarrels between Johnson and Congress: 1897–8.**
  - **b. The Question of the Freed Negroes: 2434.**
  - **c. Hayes Withdraws Troops from the South: 1611.**
- **B. Other National Questions Following the War:**
  - **a. Financial Readjustment: 3605–6.** Resumption of specie payments and the currency question 1499.
  - **b. Era of Political Corruption: 1499.**
  - **c. Hayes-Tilden Election Dispute: 1610–11, 2072.**

IX. A PERIOD OF TRANSITION: For details of foreign relations during this and later periods, see section of "Foreign Policy" at the end of the United States Outline.

- **A. Civil Service Reform:**
  - **a. Hayes Tries to Mitigate Evils of Spoils System: 1611.**
  - **b. Civil Service Commission Established: 222–3, 776.** Influence of Garfield's assassination 1399.
  - **c. Later Civil Service Reforms:** Cleveland 790, Roosevelt 3059.
- **B. Economic Reform:**
  - **a. Tariff Issue:** Contests during Cleveland and Harrison's administrations 790, 1593, 2103; Dingley Bill reinstates high duties 2104.
  - **b. Currency Reform: 3605–6.**
    - **1.** Greenback Party formed by people who believed that the generous issue of paper money would have avoided the panic of 1873 and have restored prosperity 2871; movement died out with the resumption of specie payments.
    - **2.** Beginning of the Free Silver Movement—"Crime of 1873" and Bland-Allison Act: 1499, 1611.
    - **3.** Sherman Silver Purchase Act: 1592, 791.
    - **4.** Bryan-McKinley Campaign on "16-to-1" issue: 520, 2104.
    - **5.** Gold standard adopted: 2104.
  - **c. War against Trusts:**
    - **1.** Growth of "Big Business": 3545–6.
    - **2.** Beginning of anti-trust legislation: Interstate Commerce Commission established 1794; Sherman Anti-trust Law 1592.
  - **d. Growing Importance of Organized Labor: 1947, 1487.**

X. INTERNAL AFFAIRS OF THE TWENTIETH CENTURY:

- **A. Roosevelt Inaugurates an Era of Reform: 3059–63.**
  - **a. Conservation of Natural Resources Begun: 869–70, 3060, 3062.**
  - **b. Stricter Regulation of Private Business: 3060.**
    - **1.** Anti-Trust Law enforced: 3546.
    - **2.** "Pure Food" laws passed: 2936–7.

- c. **Progress of the Labor Movement: 3060.**
  - 1. Roosevelt intervenes in the Anthracite Coal Strike: 172–3.
  - 2. Department of Commerce and Labor Established: 3600.
- B. **Taft Administration: 3428–9.**
  - a. **Continuation of Rooseveltian Policies:**
    - 1. Postal Savings Bank and Parcels Post: 2894, 329.
    - 2. Separate Department of Labor: 3428, 3600.
  - b. **High Tariff Enacted: 3437.**
  - c. **Progressive Movement Splits Republican Party: 3429, 2870, 3062.**
- C. **Democracy under Wilsonian Leadership: 3744–9.**
  - **—Continuation of Economic Reform:**
    - 1. Tariff Revised Downward: 3437.
    - 2. Banking and Finance: Federal Reserve Banking Law 1230; Farm Loan Board 1224; Federal Income Tax 3441.
    - 3. Regulation of Trusts: Federal Trade Commission established 1230; Clayton Act 3546.
    - 4. Labor Problem: Adamson Law 3747; Seamen's Act 3219.
  - **Note:** For the events connected with the World War see the Outline on the World War.
- D. **Changes in Social and Political Life:**
  - a. **Increase in the Popular Control of Government:**
    - 1. Direct Primary Elections: 2915.
    - 2. Use of Initiative, Referendum, and Recall: 1778–9.
    - 3. Direct election of United States Senators: 3428.
    - 4. Suffrage extended to women: 3778.
  - b. **Public Welfare Now a Governmental Problem:**
    - 1. More equitable distribution of taxes—income and inheritance taxes: 3441, 3428.
    - 2. Nation-wide prohibition adopted: 2920–1.
    - 3. Immigration restricted: 1738.
    - 4. Widening scope of National Government's Activities: 3593—Vocational education 3655–6; Federal Road Act 3026; Pure Food and Drugs Act 2936–7; Public Health Service 1612.
- E. **Republicans under Harding Take Up Problems of After-war Adjustment: 1582.** Charles Evans Hughes 1693; Budget System in national finance 3598.

XI. FOREIGN POLICY AND GROWTH OF A COLONIAL EMPIRE:

- A. **Settlement of Fishery Disputes with Great Britain:**
  - a. **Newfoundland Fisheries (Atlantic Fisheries Dispute): 172.** The question of the rights of American fishermen was a constant source of friction 2450: after the failure of a century of treaties to settle the matter, it was arbitrated at The Hague.
  - b. **Bering Sea Seal Fisheries: 3168, 1593.**
- B. **Beginning of our Pacific Island Interests:**
  - a. **United States Shares in the Division of the Samoan Islands: 3120, 1592**
  - b. **Annexation of Hawaii: 1605, 2104, 791.**
- C. **The Development of the Monroe Doctrine Since the Civil War: 2307.**
  - a. **France Forced to Withdraw from Mexico: 1898, 2216.**
  - b. **Arbitration of British-Venezuelan Boundary Dispute: 3622–3, 791, 172.**
  - c. **German-Venezuelan Controversy Arbitrated: 3623, 3062.**
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Interest-Questions in History

What king sat on his throne for more than 300 years? 1.
Where is there a painting 50,000 years old? 2628 (picture).
How do we know that 10,000 years ago European lakes were inhabited by men? 1957.
How did a pick and shovel make a myth come true? 29, 3137–8.
Why wasn't India conquered by Alexander the Great? 87.
How did Alfred the Great defeat the Danes by singing? 90.
Why is Albania called the "stepchild of Europe"? 79.
What present king studied shipping by being a reporter? 81.
What European ruler agreed to divide the world with Napoleon? 85.
Who discovered America 500 years before Columbus? 109.
What Englishman lost his life through Benedict Arnold? 123.
Why was a citizen of the United States fined $100 in 1872 for voting? 149.
How did science keep the Romans out of Syracuse three years? 175.
Between what two countries does a colossal bronze figure stand as a symbol of peace? 192.
How did Aristides help to banish himself? 195.
What great philospher through one pupil sent the culture of his country throughout the civilized world? 196.
How did Sir Francis Drake "singe the Spanish King's beard"? 210.
What great king was overthrown by Cortez when he conquered the new world? 288.
What ancient people were first to use iron weapons? 297.
What European king owned an African state independent of his kingdom? 859.
What great English essayist, philosopher, and statesman was convicted of receiving bribes? 301.
Who was the great leader in South American revolts against Spain? 448.
What famous king followed a spider's example and led his army to victory? 518.
What king's heart traveled without him? 518.
How did a disease bring the Middle Ages to a close? 433.

consult the Easy Reference Fact-Index at the end of this work

Why did the Portuguese give Bombay to England? 451.
What explorer received ten pounds for discoveries in the New World? 561.
Why was Cairo built on the east bank of the Nile? 566.
How did the coming of a weary traveler to Geneva influence the democracy of the United States? 587.
What famous English explorer advertised Newfoundland Banks? 616.
What gave Canada an English speaking population? 617.
Why did a Norse king of England order the sea to fall back? 639.
How did victory for the little colony of Quebec in 1610 lead to defeat in 1759? 687.
What early Frank put down anarchy? 688.
Why did the old Venetians throw a wedding ring in the sea every year? 26.
What emperor, brave in battle, feared mice and spiders? 691.
What king owed his throne to a girl general? 695.
What battle is called "the Battle above the Clouds"? 700.
What early government always had two kings at the same time? 3309.
How can stones tell the progress of man? 3361.
What famous New York governor had a wooden leg? 3375.
How did a thistle save the Scots from Norse invaders? 3489.
What general of the Civil War fought and won a battle while the order for his removal was on the way? 3490.
What great conqueror was born in the same year as the man who finally conquered him? 3716.
At what period in the history of the world were the poor paid to enjoy music and drama? 2729.
How did 300 Spartans keep back 200,000 Persians for two days? 2740.
How did the keeping of accounts give us our alphabet? 2774.
What myth influenced the discovery of Florida? 2878.
When did a whole nation go on a strike? 3043.
Why did the admission of Missouri as a state lead to a bitter quarrel? 2273.
With what religion did Mohammed wish to ally himself? 2276.
How did being blind in one eye help a famous English naval officer to victory? 2435.
Where and when were the Spaniards defeated by the ocean? 2443.
What great empire did Rurik the Northman found? 2528, 2527 (picture).
How many hundreds of years after the Crusades did the Christians as conquerors enter the Holy Land? 2643.
What tiny desert kingdom defied the Roman Empire? 2648.
What great explorer was killed by the natives of Hawaii? 874.
Who was England's "Royal Bluebeard"? 1636.
What forces of the Allies in the recent World War were driven by the Germans into lakes and bottomless mires? 1650.
What famous early explorer was cast adrift by his men to perish in the Arctic? 1690.
How was Greek influence brought to India? 1752.
How did a king and queen give to Europe a new nation and to the world a new continent? 1832.
How was a baby responsible for a revolution in England? 1861.
When in the History of the United States was socialism tried? 1861.
How did the people of Java become Mohammedans? 1879.
How was the territory of the United States doubled at one stroke of the pen? 2073.
How did Magellan navigate the globe although he died in battle with natives in the Pacific Ocean? 2116.
What woman was the wife of a king but not his queen? 2129.
Who were the first world merchants who came to England for tin? 1151.
When in the history of Paris did the price of rats rise to 60 cents apiece? 1356.
What president of the United States only served four months? 1399.
What little newspaper helped to free the slaves? 1401.
How did a single monk stop the gladiatorial contests of ancient Rome? 1466.
Why is William Crawford Gorgas called one of "America's Greatest Conquerors"? 1490.
What man in middle life rose from a common clerk to a great general and president of the United States? 1498.
What Athenian fleet might be compared to the Invincible Armada of the Spaniards? 1524.
How did ancient Greece educate its conqueror? 1525.
What English queen reigned only nine days and died on the scaffold? 1542.
Why did the invention of gunpowder help democracy? 1552, 773.
What famous king was killed just as his troops won a great battle? 1554.
What nation prevented any discussion of disarmament and arbitration in the Hague peace conference in 1907? 1559.
About what English king was it said, "No man so good was ever so bad a king"? 693.
What French king, too stingy to buy himself a new hat, helped to unify France? 2065.
How does the ill fame of the de' Medici family pop out in France? 696.
Why was there no such date as October 5th in the year 1582? 574.
Why were the Moslems unable to defeat Charles Martel? 697.
What king returned from war with only two companions? 698.
What silver tongued orator of Rome lost his life because of his famous "Philippics"? 765.
Which was the first permanent settlement in America? 716.
Why did George Rogers Clark die in poverty when he owned 8,049 acres of land in Indiana? 783.
What beautiful queen conquered two great warriors with her charms but failed with the third? 789.
Why was the name of the Thracian slave Spartacus terrible to the Romans for many years? 3310.
What Englishman ran away to New Orleans, fought in the Civil War, and helped open up a continent? 3339.
What street in New York is still named after the farm of Peter Stuyvesant? 3375.
What foreign minister of France was able to keep his position through the Directory, the Napoleonic Empire, and the restored Bourbon Monarchy? 3430.
The name of what vice-president of the United States has always been connected with treason? 542.
How did the phrase "give your John Hancock" originate? 1570.
Who was the earliest European to describe the city of Hangchow, China? 1574.
How did the phrase "Fabian policy" originate? 1575.
How was the Hanseatic League broken up by herrings? 1576.
How did the Northmen finally conquer the English from the south instead of the north? 1589.
The history of what great war is written in embroidery? 1596.
How much did Bunker Hill cost the British? 533.
Why were the Crusades a blessing to Europe? 551.
Why did the response of Europe to the Byzantine Emperor's call for help lead to the downfall of the Empire? 552.
What early American orator and political leader was called the Great Pacificator ? 785.
What great French leader in the World War at one time taught in a girl's school in Connecticut? 786.
Why were castles built during the Middle Ages? 654.
By what maneuver did the Thebans defeat the Spartan phalanx? 3486.
How did throwing a king's representatives out of a window involve Europe in 30 years of war? 3488.
How did the English government break up the first great labor movement in 1381? 3572.
How did Germany help to make the American troops of Valley Forge into an efficient army? 3615.
What great queen ruled 64 years? 3639.
Which one of the Great Lakes was the scene of a naval engagement between the English and Americans? 2730.
What country recently had for its leader a musician? 2856.
How did the French king Louis XIV avoid entertaining Peter the Great? 2747.
What czar worked in a shipyard? 2747.
What Spaniard received a room full of gold and two rooms full of silver as ransom for a great Indian chief? 2814.
What early European served as a minister extraordinary for the Grand Khan Kublai? 2874.
Why do we know so much about the private life of the Romans? 2876.
To which one of Alexander's generals was Cleopatra related? 2931.
Why did a European monarch live in South America for many years? 2890.
What great Mohammedan leader is remembered because of his courtesy and kindness of heart? 3111-2.
When was Florence a city of Puritans? 3131.
Why was the scallop the pilgrim's badge in the Middle Ages? 3134
Why were Austria, Russia, and France referred to in the Seven Years' War as the "League of Three Petticoats"? 3180.
Why was Queen Mary I of England called Bloody Mary? 2157.
What Scottish queen was forced to abdicate in favor of her infant son? 2158.
What Italian patriot was sentenced to death three times? 2178.
How did a tiny club grow into a revolution? 1859.
What French nobleman took part in three revolutions on the popular side? 1957.
Who were the first Europeans to visit Japan? 1869.
What king stood in a courtyard barefoot for three days in midwinter in order that he might win back his kingdom? 1632.
Why did General Braddock suffer defeat from marching into the wilderness with drums beating and banners flying? 1362.
What great English statesman chopped trees for exercise? 1469.
What were the trade unions of the Middle Ages called? 1459.
What man first gave France national unity? 810.

MYTHOLOGY

THE fascinating stories of Mythology represent the first efforts of primitive people to explain the origin of the world and to solve the mysteries of life which surrounded them. Woven out of the fresh imaginations of ancient generations and carried down through ages of popular approval, they need no justification on the score of interest. But in addition to this ever-renewed interest, Mythology serves many other purposes, often overlooked. A study of these stories helps us, for instance, to understand the early history and customs of the people who originated them. In this connection, a comparison of the myths of different early peoples often indicates that they had the same origin and thus sheds light upon prehistoric connections of race and culture. On the other hand, a study of the broad human similarities to be found in the myths of widely separated peoples is of the utmost value to the student of sociology and social psychology. And finally a ready understanding and appreciation of many of the finest passages in our literature is impossible unless the reader is familiar with the classical myths to which allusions are so frequently made.

I. **BABYLONIAN MYTHS OF LIFE AND DEATH: 299—Etana, the Shepherd Who Attempted to Fly; Adapa, A Fisherman Who Refused Immortality; Babylonian Story of the Flood.**

II. **ANCIENT EGYPTIAN MYTHOLOGY: 1105.**
  - A. **Osiris:** Legendary King of Egypt and Chief of the Gods 2602.
  - B. **Isis:** The Moon Goddess, Wife of Osiris 1832.

Greek and Roman Mythology

THE Mythology of the ancient Romans, a practical people, is based very largely on that of their imaginative and poetical Greek neighbors. Certain native Latin divinities have retained an individuality in Roman literature, but we find that the chief Roman deities came to be identified with certain Greek gods and goddesses, whose characteristics and adventures they assumed. For this reason we shall consider Greek and Roman Mythology together, giving the Roman names in parentheses after the Greek names.

I. **ANCIENT GREEK THEORY OF THE CREATION:**
  - A. **The Origin of Heaven and Earth:** How **Uranus** (Heaven) and **Gaea** (Earth) Came into Being (3607); Their Children—the **Cyclops, Hundred-Handers,** and **Titans** (944, 3607); Temporary Power of **Kronos** and **Rhea,** and How Their Son, **Zeus,** Finally Became the Ruler of the Universe (3607, 3838).
  - B. **The Origin of Man:** The Greeks held several theories regarding the creation of man. One story relates that **Prometheus,** son of the Titan Iapetus, fashioned man at the request of the gods. By his devotion to mankind, however, Prometheus so enraged Zeus that Zeus caused a woman, **Pandora,** to be made to bring trouble to man (2663), and ordered Prometheus chained to a rock (2921). When, later, men had fallen into evil ways, Zeus destroyed them by a flood, saving only **Deucalion,** son of Prometheus, and his wife **Pyrrha** (1000).

II. **HEAVEN AND THE DEITIES WHO DWELT THERE:** The Heaven of the Greek gods was a high mountain, **Olympus,** with a gate of clouds, opened by the Hours or Seasons to permit the passage of the heavenly deities to earth and to admit them on their return. Each god had a separate dwelling, but at the command of Zeus all repaired to his palace, even those deities who usually dwelt on the earth or in the waters or the underworld. There they feasted on ambrosia and on nectar poured by **Hebe,** as they discussed the affairs of the universe or listened to the music of **Apollo** and the **Muses.** At the setting of the sun all returned to their respective dwellings.
  - A. **The Greater Gods Who Dwelt on Mount Olympus:**
    - a. **Zeus (Jupiter), Son of the Titans, Kronos and Rhea:** Supreme Ruler of the Universe 3838, 2580.
    - b. **Hera (Juno), His Sister and Wife:** Queen Goddess and Guardian of Women 1639.
    - c. **Apollo, Son of Zeus and Leto (Latona):** God of Light and Manly Beauty and of Prophecy, and in Later Times the Sun-God 155, 991.
    - d. **Artemis (Diana), Apollo's Twin Sister:** Virgin Goddess, Huntress, as Well as Guardian, of Wild Beasts, and Later, the Moon-Goddess 220.
    - e. **Ares (Mars), Son of Zeus and Hera:** God of War 2154.
    - f. **Hephaestus (Vulcan), Son of Zeus and Hera:** God of Fire (Especially Volcanic Eruption, Incendiary Flame, and the Glow of the Forge) and the Blacksmith of the Gods 1639.
    - g. **Aphrodite (Venus):** Goddess of Love, Who Sprang Full Grown from the Sea-Foam 155.
    - h. **Hermes (Mercury), Son of Zeus:** Cunning and Swift-Footed Messenger of Heaven 1644.
    - i. **Athena (Minerva), Who Sprang Full Grown from the Brow of Zeus:** Goddess of Storms, of War, and of Wisdom, of Spinning and Weaving, and of Agriculture, and Protectress of Cities 248.
    - j. **Hestia (Vesta): Sister of Zeus and Eldest Daughter of Kronos and Rhea:** Goddess of the Hearth and Divinity of the Home 3634.
  - B. **Most Noteworthy of the Lesser Deities of Heaven:**
    - a. **Eros (Cupid):** Small God of Love, Son of Aphrodite 939.
    - b. **Hebe, Daughter of Zeus and Hera:** Cup-bearer of the Gods 1624.
    - c. **Ganymede:** a Trojan Boy Who Succeeded Hebe as Cup-bearer 1393.
    - d. **The Graces, Daughters of Zeus:** Goddesses Who Presided over Social Matters 155.

e. **The Muses, Daughters of Zeus:** Presided over the Arts and Sciences 2373.
f. **Themis, a Titan, Daughter of Uranus:** Goddess of Justice Who Sat Beside Zeus on His Throne.
g. **The Fates:** Controlled Human Destiny 1225.
h. **Nemesis, Daughter of Night:** Represented Righteous Anger and the Vengeance of the Gods 2436.
i. **Aesculapius, Son of Apollo:** His Function was the Art of Healing 679, 3257.
j. **Boreas, Zephyrus, Notus, and Eurus:** The Winds 29. Aeolus, King of the Winds, was not a Lesser Divinity of Heaven, but dwelt on the precipitous isle of Aeolia 29.
k. **Helios, Selene, and Eos (Aurora), Children of the Titan Hyperion:** Helios, Charioteer of the Sun was the more ancient Greek Sun-god, frequently identified with his successor Apollo 2759. Selene was the early Moon-goddess, whose attributes and adventures were later merged in those of Artemis. Eos was the rosy-fingered goddess of Dawn, mother of the stars and of the morning and evening breezes 259.
l. **Phosphor,** the Morning Star, and **Hesper,** the Evening Star, Sometimes Identified with Phosphor.
m. **Orion, Son of Neptune:** Mighty Hunter 2601, 2838.
n. **Eris (Discors):** Goddess of Strife 3542.
o. **Iris:** Goddess of the Rainbow 2972.
p. **Nike (Victoria):** Goddess of Victory.

III. THE EARTH AND THE GODS WHO MADE IT THEIR ABODE: The Greeks believed that the earth was a flat circle in the center of which was either Mount Olympus or Delphi, famous for the oracle of Apollo. It was crossed from east to west by the Sea (the Mediterranean and Euxine or Black Sea), while around it flowed in a steady current the Ocean Stream (personified as the Titan Oceanus), from which the Sea and all rivers received their waters. Beyond the mountains of the North Wind, in a region inaccessible by land or sea, dwelt the Hyperboreans, in bliss and everlasting spring. In the south, close to the Ocean, dwelt the Ethiopians, a people greatly favored by the gods. On the western margin lay the **Elysian Plain,** the abode of the blessed (1558). The Dawn, the Sun, the Moon, and most of the Stars rose out of the Ocean to give their light to man.

A. The Chief Gods of Earth:
a. **Demeter (Ceres), Sister of Zeus:** Goddess of Agriculture and of Civilized Life 991.
b. **Gaea or Ge, the Mother Earth, Wife of Uranus:** One of the Older Order of Gods 3607, 1640.
c. **Rhea, Wife of Kronos and Mother of Zeus:** Another Goddess of Earth 3607.
d. **Dionysus (Bacchus), Son of Zeus and Semele:** God of Wine and of Animal Life and Vegetation 1012.

B. The Lesser Divinities of Earth:
a. **Pan, Son of Hermes:** God of the Flocks and Pastures, of Fields and Forests 2648.
b. **The Nymphs,** Including the **Dryads** or Tree Nymphs; the **Oreads,** Nymphs of the Mountains and Grottoes; and the **Napaeads,** Shy Valley Nymphs: 2546.
c. **The Satyrs (Fauns):** Queer Goatlike Deities of Woods and Fields 1012, 2648.

IV. THE UNDERWORLD AND ITS DIVINITIES: "Beneath the secret places of the Earth" lay a realm of darkness, bounded by awful rivers—the sacred **Styx** and **Acheron,** river of woe—where **Hades,** whose name is given to the region, in a dark and gloomy palace haunted by strange apparitions, ruled the spirits of the dead 1558.

A. Principal Deities of Hades:
a. **Hades (Pluto), Brother of Zeus:** Ruler of the Underworld and Lord not only of All that Descends into the Earth, but of All that Proceeds from It 1558.
b. **Persephone (Proserpina), Daughter of Demeter and Wife of Hades:** Goddess of Death and also Spring 991.

B. Lesser Divinities:
a. **Aeacus, Rhadamanthus, and Minos, Sons of Zeus and Judges of the Dead:** Minos During His Life had been King of Crete 1640.
b. **Eumenides or Erinyes (Furies), Born of the Blood of Wounded Uranus:** Deities Who Attended Persephone and Punished Those Who had Escaped from or Defied Justice 1382.
c. **Hecate:** Mysterious Deity Who Represented the Darkness and Terrors of the Moon, Goddess of Sorcery and Witchcraft 1626.
d. **Hypnos (Somnus) or Sleep and Thanatos or Death, Sons of Night:** The first brought solace and fair dreams to mortals and the other closed their eyes forever. Dreams dwelt beside Death in an abode with two gates through one of which issued false dreams and through the other those which were true and noble.

V. THE GODS OF THE WATERS:

A. The Older Dynasty: The Sea had two sets of rulers, the earlier of which flourished during the reign of Kronos. The Titan **Oceanus** and his sister and queen **Tethus,** from whom sprang thousands of rivers and numerous ocean-nymphs, ruled the waters from their beautiful palace beyond the boundaries of Earth. There was also **Pontus** (the deep sea), who was the father of **Nereus,** a genial old man famous for his prophetic gifts and his love of truth and justice. Nereus' wife was **Doris,** and their children were the fifty fair **Nereids.** Of these beautiful daughters the most famous were **Panope, Galatea, Thetis** (2546), and **Amphitrite.**

B. The Younger Dynasty:
a. **Poseidon (Neptune), Brother of Zeus:** Ruler of the Waters 2891.
b. **Amphitrite, Daughter of Oceanus and Wife of Poseidon.**

c. **Triton, son of Poseidon:** a Lesser Divinity, Trumpeter of Ocean.

d. **Proteus:** Little Old Man of the Sea. He had prophetic powers and could change his shape at will 2926.

e. **The Harpies, Children of Thaumus, a Son of Pontus and Gaea: 1591.**

f. **The Graeae:** Three Hoary Witches, Gray-Haired from Birth: 2731.

g. **The Gorgons:** Three Horrible Sisters, Whose Glance was Death 2731.

h. **The Sirens:** Sea Muses Who, by Their Singing, Lured Mariners to Destruction 2562.

i. **Scylla:** Six-Headed Monster Destructive to Mariners 2563.

j. **Atlas:** A Titan, Who Supported the Heavens on His Shoulders. In later times he was regarded as a mountain rather than as a divinity of the sea 1640, 2732. Three groups of nymphs—the **Pleiades** (2838), **Hyades,** and **Hesperides** (1640), although daughters of Atlas, were not themselves divinities of the sea.

k. **The Water-Nymphs—the Odeanides, Nereids, and the Naiads:** The last of these daughters of Zeus, were of most importance 2546.

VI. ITALIAN GODS: Besides the Roman gods already mentioned, there were certain other deities always peculiar to Roman Mythology. Among them the most important were: **Saturn,** the introducer of agriculture (whom some have attempted to identify with Kronos), and **Ops,** his wife, goddess of sowing and harvest (later confounded with Rhea) 3129; **Janus,** god of doors or of beginnings, the most important native Italian deity 1861; **Quirinus,** a war god, the deified Romulus 3058; **Bellona,** a war goddess; **Lucina,** a goddess of light and of childbirth (a name applied to both Juno and Diana); **Faunus,** grandson of Saturn, god of fields, of shepherds, and of prophecy (his name in the plural refers to a group of woodland deities like the Greek Satyrs 2648, 1012); **Sylvanus,** god of the forest glades; **Pales,** goddess of cattle and pastures; **Flora,** goddess of flowers 2175; **Pomona,** goddess of fruit trees 1566; the **Lares** and **Penates,** household gods, the former being considered as the deified spirits of ancestors who watched over their descendants 3635. **Sol** (the Sun), **Luna** (the Moon), **Juventas** (Youth), **Fides** (Honesty), **Fortuna** (Fortune) 1333, and other personifications were also worshiped by the Romans.

VII. LEGENDARY HEROES: Besides these divine beings, the Greeks and Romans held in veneration a large number of demigods and heroes, of matchless worth and valor and endowed with godlike qualities which they employed in the service of mankind—in the destruction of monsters, the founding of cities, the winning of wars, and the like. Some of these legendary heroes were offspring of the gods and many of them were direct descendants of Deucalion. In the stories of some of their exploits there is a shadowy historical background, but their chief value historically is in the information they give of early life in the lands about the Aegean Sea.

A. **Older Heroes:** The following and their contemporaries may be called the Older Heroes; with them belong **Prometheus** and **Deucalion,** whose stories have been told in connection with the Creation of Man.

a. **Perseus:** Hero of Argos, Son of Zeus and Danae, who was the Daughter of King Acrisius of Argos 2731.

b. **Heracles (Hercules):** National Hero of the Greeks, son of Zeus and Alcmene, the Granddaughter of Perseus 1640.

c. **Cadmus:** Founder of Thebes, a Descendant of Zeus 563.

d. **Orpheus:** Famous Musician, Son of Apollo and the Muse Calliope 2601.

e. **Minos:** King of Crete, Son of Zeus and Europa 3487.

f. **Oedipus:** King of Thebes, Descendant of Cadmus 2566.

g. **Theseus:** Son of King Aegeus of Athens, a "Second Hercules," Slayer of the Minotaur 3487.

h. **Jason:** Heir to the Throne of Iolcus in Thessaly, Leader of the Argonauts 193.

i. **Peleus:** Grandson of Zeus, Husband of Thetis a Sea Nymth, and Father of Achilles.

j. **Pelops:** Son of Tantalus.

k. **Castor and Pollux:** Twin Sons of Zeus 657.

B. **The Younger Heroes:** These were sons and grandsons of the Older Heroes and chieftains in the Theban and Trojan Wars and in numerous other military expeditions. Their exploits are narrated in four stories: **The Seven Against Thebes, The Siege of Troy, The Wanderings of Odysseus (Ulysses),** and **The Adventures of Aeneas.** Among them were **Achilles, Nestor, Agamemnon, Hector, Aeneas,** and many other valiant warriors.

VIII. MYTHS OF THE GODS:

A. **Stories of the Greater Gods:**

a. **Myths of Zeus:** His Love for Io 1802; Zeus and Callisto, a Maid of Arcadia 872; Abduction of Europa 563; The Punishment of Tantalus 3433.

b. **Myths of Athena: 248**—Her Birth; Helping the Greeks at Troy; the Naming of Athens; Weaving Contest with Arachne.

c. **Myths of Apollo and Artemis:** Apollo and the Deadly Python 156; Hyacinthus and Apollo 1706; The Punishment of Niobe 2510; Apollo's Revenge on King Midas 2230; The Musical Contest of Apollo and Marsyas 156; Apollo's Love for the Nymph Daphne 962; The Fate of Acteon at the Hands of Artemis 220; Orion and Artemis 2601.

d. **Myths of Aphrodite:** Birth 155; Aphrodite and Adonis 26; Wedding of Aphrodite and Hephaestus 155; Atalanta's Race 247; Hero and Leander 1645.

e. **Some Early Adventures of Hermes: 1644.**

f. **The Battle of Ares and Diomede: 248.**

- g. **Dionysus and the Pirates 1012; Midas and Dionysus 2230.**
- h. **Abduction of Persephone by Hades: 991.**
- i. **Poseidon and the Building of Troy 2891.**

B. Myths of the Lesser Divinities:
  - a. **Myth of Phaethon, Son of Helios, and the Nymph Clymene: 2759.**
  - b. **Aesculapius and Chiron: 678.**
  - c. **Myth of the Pleiades, Nymphs of Artemis' Train: 2838.**
  - d. **Cupid and Psyche: 939.**
  - e. **Aurora and Tithonus: 259.**
  - f. **Pan and Syrinx: 2376.**
  - g. **Echo (an Oread) and Narcissus: 1073, 2397.**
  - h. **Myth of the Dryads: 2546.**

IX. MYTHS OF THE DEMIGODS AND HEROES:

A. Stories of the Older Heroes:
  - a. **Myths of Perseus: 2731**—The Doom of King Acrisius; Perseus and Medusa; Perseus and Atlas; Perseus and Andromeda.
  - b. **Myths of Heracles: 1640**—His Youth; His Labors; Further Exploits; Death.
  - c. **The Argonauts' Quest of the Golden Fleece: 193.**
  - d. **Myths of King Minos of Crete:** The Minotaur 1640; Daedalus and Icarus 949.
  - e. **Myths of Theseus:** Theseus and Ariadne 3487; Theseus and Pirithous and the Battle with the Centaurs 3487, 678.
  - f. **Orpheus and Eurydice: 2601.**
  - g. **Founding of Thebes by Cadmus: 563.**
  - h. **Myths of Oedipus: 2566**—Youth; Murder of His Father; Oedipus and the Sphinx; Oedipus and King; Exile and Death.

B. Myths of the Younger Heroes:
  - a. **The War Against Thebes: 2566**—Causes; Antigone; Creon Becomes King.
  - b. **The Trojan War.**
    1. **Its Origin:** The Story of Paris, Son of King Priam of Troy 2680; Marriage Feast of Peleus and Thetis 3542; Paris Abducts Helen, Wife of King Menelaus 3542.
    2. **Greek Heroes Who Took Part:** Achilles, Son of Peleus and Thetis, the Bravest of the Warriors 8; Odysseus, King of Ithaca 2562; Ajax the Great, Second only to Achilles in Strength and Bravery 69; Agamemnon, King of Mycenae, Commander-in-chief of the Greek Forces; Gallant Diomedes, Aged Nestor, King of Pylos, and others.
    3. **Chief Trojan Leaders:** Hector, Son of King Priam, One of the Noblest Figures of Antiquity 1626; Aeneas, Son of Anchises and Aphrodite 29. Among the Trojans' Allies was Memnon, King of Ethiopia 2196.
    4. **Story of the War: 3543.** The Wrath of Achilles 8; the Shield of Achilles 9; Battles of Diomedes 155, 248; the Amazons 106; the Death of Hector 1626; Story of the Wooden Horse and the Fall of Troy 3543; the Return of Menelaus to Greece 2926.
  - c. **The Wanderings of Odysseus:** The Lotus-Eaters 2562; the Cyclops 944; the Bag of Winds 29; Odysseus and Circe 767; the Sirens 2562; Scylla and Charybdis 2563; the Island of Calypso 2563; the Princess Nausicaa 2564; Penelope and the Suitors 2564; Return of Odysseus 2565.
  - d. **Adventures of Aeneas 29.**

Norse and Teutonic Mythology

THE Mythology of the Northmen, who inhabited the countries now known as Sweden, Denmark, Norway, and Iceland, has come down to us chiefly through the Eddas and Sagas (3134). Although it is distinct from that of the Greeks and Romans, a certain similarity is apparent in many essential features. Cradled in the frozen North, the Scandinavian myths image the spirit of the hardy Viking race, and while their gods lack the graceful fancy of the Greek deities they have a rugged personality well calculated to inspire the warlike Northmen to deeds of prowess. The old Germanic peoples accepted the Norse deities as a whole for their own, and their myths are based so largely on the Scandinavian that they have retained little separate identity.

I. THE GODS AND THEIR MYTHS:

A. **The Creation:** Scandinavian myths, like those of the Greeks, tell of the development of the world from darkness and chaos. Originally there existed a world of mist, a bottomless deep, and a world of light. From the mist-world issued twelve rivers whose frozen waters gradually filled up the bottomless deep. Then from the world of light issued warm winds which melted the ice, producing vapors which rose and formed clouds. From these clouds sprang **Ymir,** the rime-cold giant, and his progeny, and a cow, **Audhumbla,** whose milk furnished nourishment to the giant, and who in turn was nourished by licking the hoar frost and salt from the ice. Finally there appeared first the hair, then the head, and at length the whole form of a god of great beauty and power. This was **Bori,** from whom and his wife, a daughter of the giants, sprang **Odin, Vili,** and **Ve.** These three slew Ymir and from his body and blood formed heaven and earth. Of his eyebrows they built a fence around **Midgard,** the destined abode of man. Having created the world they fashioned man from an ashen spar and woman from a piece of elm. To these first human beings Odin gave life and soul, Vili, reason and motion, and Ve, the sense, features, and speech. The universe was supported by **Ygdrasil,** a mighty ash tree (2560, 3534).

- B. **Asgard, Abode of the Gods, and Its Chief Dieties: 2560, 3135.**
  - a. **Odin or Woden:** Ruler of Heaven, Earth, and the Underworld, Who Lived in a Golden Palace Called Valhalla.
  - b. **Frigga:** Odin's Wife, Who Knows All Things.
  - c. **The Valkyries:** Warlike Virgins Mounted on Horses and Armed with Helmet, Shields, and Spears, Who Conveyed Fallen Warriors from the Battlefields to Valhalla.
  - d. **Thor:** The Thunderer, Eldest Son of Odin 3490.
  - e. **Bragi:** Son of Odin, and God of Poetry.
  - f. **Iduna:** Bragi's Wife; Custodian of the Casket of Magic Apples, Which Produce Immortal Youth 3135.
  - g. **Balder:** Son of Odin; Beautiful God of Sunlight, Spring, and Gladness 306.
  - h. **Hoder:** Son of Odin, Blind God of Winter.
  - i. **Frey:** God of Fruitfulness; **Freyja:** His Sister, Goddess of Love.
  - j. **Tyr:** A Wrestler, "God of Battles."
  - k. **Loki:** The Mischief-Maker, Who, Though of the Demon Race, Forced Himself into the Company of the Gods. One of his children was the **Migard Serpent,** who encircled the Earth.
- C. **Jotunheim and the Frost Giants, Enemies of the Gods 2560, 3490.**
- D. Some Myths of the Gods:
  - a. **Odin at the Fountain of Knowledge: 2560.**
  - b. **The Apples of Iduna: 3135.**
  - c. **Thor's Visit to Jotunheim: 3490.**
  - d. **The Death of Balder: 306.**

II. **MYTHS OF NORSE AND OLD GERMAN HEROES:** In the Norse Saga of the Volsungs are gathered many ancient legends, with **Sigurd,** a great hero never equaled in comeliness, valor, and great-heartedness, as the central figure. The great epic, **Nibelungenlied,** is the German version of these hero-tales, with certain variations of name, character, and incident. Here Sigurd appears as **Siegfried.**

- A. **The Story of Siegfried: 3230.**
- B. **The Songs of the Nibelungs: 2504.**

Books of Mythology, Folk Lore, and Fairy Tales

FIRST AND SECOND GRADES

In Mythland. M. Helen Beckwith.
Nature Myths of Many Lands. Florence V. Farmer.
Book of Nature Myths. Florence Holbrook.
Stories of the Red Children. Dorothy Brooks.
Legends of the Red Children. Mara L. Pratt.
Myths of the Red Children. Gilbert L. Wilson.
Nights with Uncle Remus. Joel Chandler Harris.
Uncle Remus and the Little Boy. Joel Chandler Harris.
Green Fairy Book. Andrew Lang.
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Stories of Greek Gods, Heroes and Men. Samuel B. Harding.
Gods and Heroes. Robert E. Francillon.
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The Story of Troy. Michael Clarke.
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Old Greek Stories. James Baldwin.
Story of the Golden Age. James Baldwin.
The Golden Fleece. James Baldwin.
Stories of the Ancient Greeks. Charles D. Shaw.
Wonder Stories. Carolyn S. Bailey.
Four Old Greeks. Jennie Hale.
Adventures of Ulysses. Charles Lamb.
Adventures of Odysseus. F. S. Marvin and others.
Child's Guide to Mythology. Helen A. Clarke.
Myths that Every Child Should Know Hamilton Wright Mabie.
Heroes. Charles Kingsley.
Aesop's Fables. Translated by V. S. V. Jones.
Viking Tales. Jennie Hall.
Norse Stories Retold from the Eddas. Hamilton Wright Mabie.
Story of Siegfried. James Baldwin.
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Stories of King Arthur and His Round Table. Beatrice Clay.
Old Indian Legends Retold. Zitkala-Sa.
Wigwam Evenings—Sioux Folk Tales Retold. Charles A. Eastman and Elaine G. Eastman.
Pueblo Indian Folk Stories. Charles F. Lummis.
American Indian Fairy Tales. Margaret Compton.
Indian Folk Tales. Mary F. Nixon.
Arabian Nights. Edited by Kate Douglas Wiggin.
Chinese Fables and Folk Stories. M. H. Davis and Chow Leung.
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Folk Tales from the Russian. V. X. K. de Blumenthal.
Russian Grandmother's Wonder Tales. Louise Houghton.
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Scottish Fairy Book. E. W. Gierson.
Celtic Fairy Tales. Joseph Jacobs.
More Celtic Fairy Tales. Joseph Jacobs.
Brown Fairy Book—Violet Fairy Book—Yellow Fairy Book—Blue Fairy Book (4 vols.). Andrew Lang.

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Classic Myths in English Literature and in Art. Charles Mills Gayley.
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Golden Age of Myth and Legend. Thomas Bulfinch.
The Beliefs of the Egyptians. F. H. Brookshank.
The Myths of Greece and Rome. Hélène A. Guerber.
Story of the Iliad. Alfred J. Church.
Wonder Tales of the Ancient World. James Baikie.
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Viking Tales of the North. Rasmus Björn Anderson.
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Knightly Legends of Wales, or the Boys' Mabinogion. Sidney Lanier.
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Stories from the Faerie Queene. Mary MacLeod.
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Tales of the Punjab. Flora A. Steel.
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Legends of Switzerland. Hélène A. Guerber.
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Myths and Legends of the Mississippi Valley and the Great Lakes. Katharine B. Judson.
Myths and Legends of the Pacific Northwest. Katharine B. Judson.

HIGH SCHOOL AND AFTER

The Mythology of All Races. L. J. Gray.
Myths and Myth-Makers. John Fiske.
The Golden Bough. J. G. Frazer.
Romance and Legend of Chivalry. A. R. H. Moncrieff.
Custom and Myth. Andrew Lang.
The Making of Religion. Andrew Lang.
Myth, Ritual, and Religion. Andrew Lang.
Contributions to the Science of Mythology. Max Müller.
Primitive Culture. E. B. Tylor.
The Dawn of History: an Introduction to Prehistoric Study. **C. F.** Keary.
Religion of Primitive Peoples. D. G. Brinton.
Religion of Ancient Egypt. P. L. Renouf.
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Sketch of Semitic Origins. G. A. Barton.
Mythology of the Aryan Nations. G. W. Cox.
Religions of India. E. W. Hopkins.
Bengal Fairy Tales. F. B. Bradley-Birt.
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Myths and Legends of Our Own Lands. C. M. Skinner.
Myths of the New World. D. G. Brinton.
Latin-American Mythology. Hartley Burr Alexander.
Songs and Tales from the Dark Continent. Natalie Curtis.

Interest-Questions in Mythology

What goddess sprang from the sea-foam? 155.
How did the ancient Greeks explain the change of seasons? 991-3.
Why is the laurel associated with poets? 962, 2848.
How did it happen that the most beautiful of the Greek goddesses became the wife of the most awkward of the gods? 155.
How did the ancient Greeks explain the origin of fire? 2921.
The name of what Roman god is contained in the word "vulcanize"? 1639.
What poet escaped death through his power of song? 194.
How did three golden apples help a hero to win a race and a wife? 248.
What great Greek city is named for a goddess? 249.
What woman, according to the Greeks, was responsible for all the ills of mankind? 2663.
What happened when a man was given immortal life without immortal youth? 259.
How, according to the Babylonians, was the gift of immortality lost to mankind? 299.
What girl was turned into a spider? 249.
What did the sowing of dragon's teeth have to do with the founding of a great city? 563.
What god had wings on his shoes? 1644.
What god was most often represented in Greek art? 157.
What twins were set among the stars after their death? 657.
What is meant when a horseman is said to "ride like a Centaur"? 678.
What sorceress changed men into beasts? 767, 768.
What woman brought disaster on herself through her curiosity concerning her husband? 939.
What connection is there between "cereal" and a Roman goddess? 993.
What goddess represented the dark of the moon? 1626.
Who, according to the ancient Greeks, was the first man to fly? 949.
What Babylonian hero attempted to soar to heaven on an eagle's back? 299.
What flower sprang from the blood of a beautiful youth? 1706.
How, according to the Greeks, did the peacock get the "eyes" in its tail? 1802.
Why should sudden unreasonable fear be called a "panic"? 2648.
What god mistook a stone for his child? 3607.
What Greek boy was carried off to heaven by an eagle? 1393.
How did the Romans get the name of their chief god? 1903.
What youth gazed at his own image until he was transformed into a beautiful flower? 2397.
How did the ancient Greeks think their poets and artists were inspired? 2373.
What substance, much valued for jewelry, came from the tears of maidens who wept for their dead brother? 2759.
How did the Northmen explain the coming of winter? 3135.
Who was the old woman whom no god could conquer? 3492.
How did a goddess unwittingly slay her lover? 2601.
How did a brightly polished shield help Perseus to slay a monster? 2731.
What hero removed his war helmet because his little son was afraid of it? 1626.
How was a northern hero enabled to understand the language of birds and beasts? 3231.
How did a Greek hero in trying to avoid harming his father unknowingly kill him? 2566.
How did Odysseus and his men get past the giant Polyphemus without being seen? 945.
What river in Africa was made to overflow by the tears of a goddess? 1832.
How did the god of the vine keep a ship from moving? 1012.
Who was the mischievous god that escaped from his cradle and began his adventures when only a few hours old? 1644.
Which of the Greek heroes was called "the crafty"? 2562.
What Roman heroes were brought up by a wolf? 3058.
What common metal was named after a god and why? 2199, 2200.
How did a goddess punish a mortal who saw her unattired? 221.
What goddess sprang from the head of Zeus? 248.
Who was the god of music? 156.
What planet is named after the Roman war god and why? 2154.
What strait was called "Oxford" in Greek and why? 468.
How was the lyre invented? 1644.
What flower is named after the goddess of the rainbow? 1814.
What happened when a rash youth attempted to drive the chariot of the sun? 2759.
Who was the first person to be "tantalized"? 3433.
What heroine dared to break the laws of a king in obedience to a higher law? 2566.
In what mythical country did women have all the rights? 106.
What hero in disguise was recognized by his dog though no one else knew him. 2565.
What Norse god gave an eye for wisdom? 2560.
After what god is the fourth day of the week named? 2560.
What wife of a Greek hero was noted for her fidelity? 2564.
How did a maiden in trying to protect her lover bring about his death? 3231.
How did the Northmen believe the universe was held together? 2560.
How did a wooden horse bring victory when brave warriors failed? 3543.
What teacher who was a half horse instructed many famous heroes? 678.
What old man of the sea tried to avoid prophesying by changing form? 2926.
How did a woman's beauty lead to a great war? 3542.
From what Greek hero is the tendon of the heel named and why? 8.
What flower sprang from the tears of a goddess? 123, 26.
What power moved the god of the underworld to allow one of the dead to return to life? 2602.
What river bound the oaths of men and gods? 2759.

SOCIAL SCIENCES

UNDER the name of "Social Sciences" are included those branches of knowledge which deal with the problems of men in their relations with one another. Just as Biology is concerned with the natural laws which govern the physical structure and function of individual organisms, so the Social Sciences seek to discover the laws which govern the structure and function of social organisms. The Social Sciences deal with human conduct and with the influences which shape human conduct. In this sense, of course, their interest extends to all other fields of knowledge. Their own particular scope, however, is to define and describe the *general principles* which appear to govern human conduct, as opposed to History, for instance, which seeks primarily to narrate and interpret *particular instances* of human conduct. For practical purposes the primary Social Sciences are usually divided into Sociology (3270), Economics (1076), and Political Science or Government. The name Sociology is often applied broadly to the whole group of Social Sciences, but in its more restricted sense it deals with those phases of human conduct which are governed by usage and custom rather than those which are the outgrowth of political or economic necessity; it seeks to investigate the "social habits" of the human race and their effects upon human welfare. Economics deals with the activities of men in producing, distributing, and consuming the valuable things of the earth. Political Science deals with the organization and life of the state. The name of "Civics" is often given to that department of Political Science which deals with the practical machinery of our own government and our duties as citizens. The Science of Education, which deals with political as well as purely Sociological problems, has come to be so important that it is often made a fourth great division of the Social Sciences. The articles on Geography (1413), History (1653), and Civilization (771) will provide a valuable background for the review of the Social Sciences.

Sociology

I. **ANTHROPOLOGY: 149.** The study of man's physical development, his place in nature, and the origin of culture, with particular reference to primitive life and the survival of primitive modes of living and methods of thought. Read also the article on Man 2133.

II. **ETHNOLOGY: 149.** The study of the various races and their customs, with a view of finding out their origin and relationships.
   - A. **Races of Mankind: 2956, 3866.**
   - B. **Cave Dwellers: 666.**
   - C. **Stone Age: 3360.**
   - D. **Superstitions and Magic Practices of Primitive Peoples: 2117.**
   - E. **Mythology: 2386.**

III. **PHILOLOGY: 2770.** The science which deals with the formation of languages. By the study of words used by early peoples, scientists have been able to ascertain many important things about the people who made the words and their mode of life.
   —Writing and Its Contribution to Civilization: 3816, 100, 773.

IV. **SOME IMPORTANT CUSTOMS AND INSTITUTIONS AND THEIR ORIGIN:**
   - A. **Family: 1223.** Its origin and importance as a social unit.
   - B. **Origin of Personal Names: 2388.**
   - C. **Magic and Witchcraft: 2117, 3773.**
   - D. **Folklore: 1316.** The tales and songs and dances which furnished amusement for the peoples of long ago, and the modern revival of Folk Dancing.
   - E. **Architecture and What It Tells Us of Human Progress: 176.**
   - F. **Costume and Adornment: 897.**
     - a. **Tattooing: 3440.**
     - b. **Armor: 214, 1933.**
     - c. **Uniforms: 3575.**
     - d. **Shoes of Different Periods and Lands: 3220.**
     - e. **The History of Hats and Origin of the Custom of Lifting the Hat: 1597.**
     - f. **How Buttons Came into Use: 548.**
     - g. **Ornamental Use of Feathers: 1229.**
     - h. **How Man has Toiled for Furs: 1389.**
     - i. **Lace and Its Early Uses: 1949.**
     - j. **Decorations of Honor: 976.**
   - G. **Etiquette: 1183.** The essentials of good manners as established by custom.
   - H. **Holidays and Festivals: 1673.**
     - a. **Arbor Day: 173.**
     - b. **Christmas and How It is Celebrated in Different Countries: 758.**
     - c. **Easter—Its Significance and Some Customs Connected with It: 1070.**
     - d. **Hallowe'en and Its Superstitions: 1566.**
     - e. **Memorial Day and Its Purpose: 2196.**
     - f. **New Year's Day in Various Parts of the World: 2478.**

g. **The Passover: 2691.** The Jewish festival of freedom and how it is observed.
h. **St. Patrick's Day and Some Legends of St. Patrick: 2694.**
i. **The Sabbath and Its Observance: 3103.**
j. **St. Valentine's Day and Its Customs: 3111.**
k. **Thanksgiving Day and Its Origin: 3482.**
l. **The Origin and Use of Fireworks in the Celebration of Holidays: 1264.**

V. AMUSEMENTS, GAMES, AND SPORTS:
A. **Olympic Games of the Ancient Greeks: 2580.**
B. **Gladiatorial Combats of the Romans: 1466.**
C. **Medieval Tournaments: 1933, 3152.**
D. **Modern Sports and Games:**
a. **Sports and Games of Physical Skill:** Football 1324; Baseball 338; Cricket 919; Tennis 3469; Golf 1484; Hockey 1669; Curling 940; Polo 2873; Lacrosse 1954; Croquet and Roque 926; Boat Racing 444; Swimming 3410; Skating 3753; Skiing 3754; Basketball 343; Billiards 392; Bowling 475; Fencing 1231; Boxing 476; Wrestling 3815.
b. **Indoor Pastimes:** Charades 687; Checkers 707; Chess 716; Playing Cards 643.
c. **Children's Games: 2834.**
d. **The Function of Athletics: 251.**
E. **Camping: 594.**
F. **Toys and Dolls: 3521, 1025.**
G. **Theaters and the Drama: 1031, 3482.**
a. **Miracle and Morality Plays of the Middle Ages: 2259.**
b. **The Pageant: 2625.** Its history and importance today.
c. **Motion Pictures: 2341.**

VI. SOCIAL ORGANIZATIONS: In the complicated social life of today one great branch of man's activities centers about the clubs, societies, or lodges which have been formed for the pursuit of a common interest, whether it be philanthropic, civic, cultural, religious, or purely recreational.
A. **Religious or Semi-religious Organizations:**
a. **Crusading Orders: 932, 2131.**
b. **Salvation Army: 3119.**
c. **Young Men's Christian Association: 3832.**
d. **Young Women's Christian Association: 3833.**
e. **Women's Christian Temperance Union: 3777.**
—**Work of Frances Willard: 3737.**
B. **Fraternal Organizations:**
a. **Freemasons: 1361.**
b. **Knights of Columbus: 1935.**
c. **Knights of Pythias: 957.**
C. **Women's Clubs: 3777.**
D. **Patriotic Societies in the United States: 2695.**
E. **Boys' and Girls' Societies:**
a. **Boy Scouts and Girl Scouts: 479, 1464.**
b. **Campfire Girls: 592.**
c. **George Junior Republic: 1430.**

Note: For Gilds, Coöperative Societies, Labor organizations and so forth, see the Study Outline on Economics.

VII. PROBLEMS OF SOCIOLOGY AND HOW THEY ARE HANDLED:
A. **Protection of the Weak and the Unfortunate:** One of the greatest problems of Sociology is the care of those who are incapable of self support, of whom there are many in every community or nation.
a. **Child Welfare:** Baby Care 291; Child Training 729; Play and Playgrounds 2832; Child Labor Laws 728; Compulsory Education 1086, 3138.
b. **Care of the Old and Disabled:** Pensions 2722; Education of the Blind 436; Education of the Deaf 970; Vocational Education of Maimed and Disabled Persons 3653.
c. **Care of Paupers, Defectives, and Delinquents:** Poor Laws 2878; Eugenics 1187; Juvenile Courts 1906; Prisons and Punishment 2918.
d. **The Negro Problem in the United States: 2434.**
—**Work of Booker T. Washington: 3674.**
B. **Organizations and Institutions for the Preservation of Health and the Relief of Suffering:**
a. **Public Health Service: 1612.** Quarantine; factory and food inspection; visiting nurses; hospitals.
—Pure Food Laws: 2936.
b. **Red Cross: 2983.**
C. **Private Philanthropy:** Besides the public channels through which social work is carried on, individuals often contribute their personal efforts or their fortunes to the relief of suffering, the advance of education, and to various other causes which are of benefit to humanity.
a. **Social Settlements: 3269.** A comparatively recent development in social work is the settlement house, situated in the poorer districts of cities, where educated men and women live that they may come in contact with the poor, improve conditions among them, and give them opportunities for advancement.—Jane Addams and Hull House: 16.

- b. **Well Known Philanthropies Having as Their Object Education and Scientific Research:**
  - **1.** Gifts of John D. Rockefeller: 3034—Rockefeller Institute, Rockefeller Foundation, and others.
  - **2.** Andrew Carnegie's Gifts: 646.
  - **3.** Rhodes' Scholarships: 3011.
  - **4.** Nobel Prizes: 2512.
- c. **Some Prominent Philanthropists Who Have Labored for Suffering Humanity:**
  - **1.** Florence Nightingale, the greatest of war nurses: 2509.
  - **2.** Clara Barton, another war nurse, who founded the American Red Cross: 337.
  - **3.** Wilfred Grenfell and his work as a medical missionary: 1541.

Economics

- **I. LAND: 1077.** Land is considered the basis of all wealth because it is the source of all the raw materials of production. The share which Land receives from the production of wealth may be measured in terms of **Rent.** **—The Development of Agriculture and Its Economic Effect: 43, 772.**
- **II. LABOR AND CAPITAL: 1077.** The second great factor in the production of wealth is Labor, and Labor's share of wealth is measured in **Wages.** The third element is Capital, or accumulated wealth from which its owner expects to derive an income; its share of wealth is measured in **Interest.**
  - **A. Division of Labor: 1076, 43.**
  - **B. Enforced Labor—Slavery and Serfdom: 3248.**
  - **C. Industrial Revolution and the Factory System: 1778, 1218.**
  - **D. Organization of Labor: 1947.**
    - **a. Medieval Gilds, Forerunners of Modern Labor Unions: 1459.**
    - **b. Gompers and the American Federation of Labor: 1487, 1947.**
    - **c. Use of Boycott by Labor Unions: 476.**
    - **d. Race Problem in the United States: 2434.**
  - **E. Labor Legislation:**
    - **a. Factory Laws: 1218.**
    - **b. Child Labor Laws: 728.**
    - **c. Employers' Liability: 1145.**
  - **F. Arbitration and the Labor Problem: 172.**
  - **G. Sweatshop System: 3400.**
  - **H. Socialism and Labor: 3268, 2156.**
- **III. MANAGEMENT AND THE ENTREPRENEUR: 1077.** The last agency in the production of wealth is the "man of enterprise," or manager through whose efforts Land, Labor, and Capital are brought together and put to productive use.
- **IV. FINANCE:** The work of obtaining and using money and credit for the support of public and private enterprises.
  - **A. Money: 2281.** Origin and Nature of Money: Bimetallism; the Gold Standard; Paper Money; "Quantity Theory"; Making Money.
  - **B. Credit and Banking: 917, 327.**
    - **a. Building and Loan Associations and Other Types of Coöperative Banks: 528, 879.**
    - **b. Federal Reserve System: 1230, 328, 3746.**
    - **c. Farm Loan Banks: 1224, 328.**
    - **d. Trusts and Trust Companies: 3546.**
    - **e. Postal Savings Banks and Postal Money Orders: 2894.**
    - **f. Stocks and Bonds: 3358.**
    - **g. Promissory Notes: 2725.**
    - **h. Banknotes: 2282.**
    - **i. Interest: 2724.**
    - **j. Bankruptcy: 326.**
  - **C. Public Finance:**
    - **a. Taxation: 3440.**
      - **1.** Tariff and free trade: 3437.
      - **2.** Stamp duties: 3337.
      - **3.** Income and inheritance taxes: 1741, 3441.
      - **4.** Licenses and excises: 3441.
      - **5.** Single tax: 3442.
    - **b. National Debt: 2399.**
- **V. PRODUCTION AND DISTRIBUTION:**
  - **A. Organizations for Production and Their Regulation:**
    - **a. Corporations and Partnerships: 893.**
    - **b. Trusts: 3545.**
    - **c. Coöperative Societies: 879.**
    - **d. Federal Trade Commission: 1230.**
    - **e. Public Utilities: 2932.**
    - **f. The Question of Government Ownership: 2932.**

- B. Commerce and Transportation: **862, 3524.**
  - a. Railroads: **2962.**
  - b. Postoffice: **2893.**
  - c. Ships: **3207.**
  - d. Interstate Commerce Commission: **1794.**
  - e. Embargoes: **1140.**
- C. Boards of Trade: **440.**
- D. Conservation: **869.**

VI. INSURANCE: **1791.**

Political Science (Civics)

I. **ORIGIN OF GOVERNMENT:** If man were a solitary creature who did not come in contact with his fellows, he might do as he pleased without any restraint unless by the law of nature. But man early learned that it was to his advantage to live and work with his fellow men, and found himself better able to survive and make progress in society than out of it. And so his liberty became limited by such rules as were necessary for the public good. The original social unit seems to have been the family, from which developed the clan or tribe, giving rise to the tribal or patriarchal form of government (1223). By gradual evolution this early system gave place to the complex organization now known as the state, a term used primarily to designate any community having an independent existence and possessing a sovereign government (3346). Government, then, is the machinery by which a state makes or enforces the rules of action which are necessary to enable men to live together in peace and security.

II. **FORMS OF GOVERNMENT:**

- A. **Monarchy:** A government in which the sovereign authority is vested in one person, called a Sovereign, Monarch, King, Emperor, etc., while those under his rule are called his Subjects; it is usually hereditary, but may be elective. Monarchies are divided into two classes:
  - a. **Absolute Monarchy:** One in which the ruler's power is unlimited by any principles of government; it is sometimes called an autocracy, and if the rule is cruel or severe, a despotism or tyranny. Absolute monarchies are now rare. The nearest approach to them survives in such states as Afghanistan and Abyssinia.
  - b. **Limited Monarchy:** One in which the ruler is limited in the exercise of his power by a constitution; it is also called a constitutional monarchy. Spain (3306) and Italy (1838) are examples, as is also Great Britain, where the ruler, though theoretically possessing sovereign power, is in fact so limited by the constitution as to make the government practically a democracy (1161, 1153).
    - —**Feudal System: 1235.** Under this system which has flourished in various countries at various periods, the King was the nominal owner of all the land. It was distributed, however, as "fiefs" among his Vassals, who owed him in return homage and military aid in time of need. These royal Vassals in turn distributed their land in smaller fiefs to lesser Vassals, and so on down. Each Vassal was, in theory at least, the absolute ruler of his domain, and often became more powerful than the Overlord or even than the King himself.
- B. **Aristocracy:** A State ruled by a few nobles; literally the name means "rule of the best," and the ideal aristocracy was controlled by a few men of superior wisdom, who ruled conscientiously in the interest of the people; when those who held the power did so, not by virtue of character, but by virtue of birth or wealth, and allowed their own selfish interests to predominate, the Aristocracy became an **Oligarchy**. This type of government no longer exists, but Rome was so ruled before the empire (3046), and in modern history, the so-called Republic of Venice (3625), which terminated at the close of the 18th century, was another good example.
- C. **Democracy:** A government in which all the members of the state possess an equal share of the sovereignty. Democracies may be of two kinds:
  - a. **Pure Democracy:** One in which the government is carried on directly by all the people of a community. This form is impossible in large and thickly populated states and is now found only among savage tribes and as a form of local government in small towns.
  - b. **Representative Democracy, Republic, or Commonwealth:** One in which the government is delegated to a body of men, elected by the members of the state or **Citizens** (768) as they are called. The United States government is a representative democracy.
- D. **Other Political Forms and Doctrines:** Under the name of **Socialism** or **Communism** (3268) are included those plans of government in which the state owns and controls for the equal benefit of every citizen all essential industries and means of distribution. The Bolshevist or Soviet government of Russia is the only large-scale test of Socialism which has been made (450, 3095). The doctrine of **Anarchism** (3269) demands the complete abolition of the state as it exists today, substituting instead some form of industrial cooperation in which, according to the supporters of this doctrine, the common interest of all in the success of each enterprise would make governmental control and regulation unnecessary.

Note: A government may be single or **unitary,** that is it may consist of a single state in which there is single sovereignty, or it may be **federal,** consisting of a union of states which have surrendered their right to act independently in matters pertaining to the common interest, while in other respects they have retained complete independence. The United States has a federal government, while France, for instance, has a unitary government.

III. CONSTITUTIONS: With the wane of absolute monarchies and the growing tendency toward democracy, the authority of rulers came to be limited or defined by Constitutions. While constitutional government is of comparatively modern origin, the idea it involves—that of agreement between ruler and people, or among the people themselves—is very ancient. The first such agreement in England took the form of a charter, the famous Magna Carta, granted to the English barons in 1215 by King John (2121). Other historic documents of the kind are the English Bill of Rights (393), several provisions of which are found almost word for word in amendments to the United States Constitution; and the constitution prepared by the French Assembly at the time of the Revolution, which contained the immortal "Declaration of the Rights of Man" (1368, 393). Every democracy has a constitution as its basis of government. It may be either written or unwritten. Read the article on the drafting and provisions of the **United States Constitution** (3592).

IV. FUNCTIONS OF GOVERNMENT: A government, no matter what its form may be, has three functions, known as **Legislative, Judicial,** and **Executive.**

V. LEGISLATIVE BRANCH: The function of the legislative department of a government is to make the laws. In the United States the legislative branch is sharply separated from the executive branch of the government, but in countries like England, which have the parliamentary form of government, the line is not so clearly drawn.

- A. **Laws and Law Making: 1972.**
  - **— Justinian and the Roman Civil Law 1905; the Code Napoleon 2394-5.**
- B. **British Parliament: 2687.** The law-making body for the British Empire and the oldest legislative assembly in existence.
  - —**Cabinet: 555.** Note the important part the British cabinet takes in the proceedings of Parliament, as opposed to the functions of the United States cabinet which are purely administrative. This is a distinguishing feature of "parliamentary" governments.
- C. **United States Congress: 3593, 860.** The Senate and the House of Representatives, the two bodies which constitute the law-making organization of the United States government; how they are elected; their powers; the machinery for making a law.
  - a. **The Vice-President, the Presiding Officer of the Senate: 3637.**
  - b. **Some Specific Powers of Congress:**
    - **1.** Impeachment: 1740. In using this power Congress acts in a judicial capacity.
    - **2.** Establishing a system of weights and measures: 3714.
    - **3.** In Treaty-making: 3529.
    - **4.** In establishing bankruptcy laws: 326.
    - **5.** Extra-territorial powers: 3601.
  - c. **Duties in Election of President: 2914.**
  - d. **Citizenship and Naturalization Laws: 768, 2405.**
  - e. **Patent and Copyright Laws: 2692, 884.**

VI. EXECUTIVE BRANCH: That branch of government which administers and enforces the laws. We may take the executive organization of the United States Government and its duties as an example (3596).

- A. **The President: 2913, 3594.** The chief executive of the United States; necessary qualifications for office; manner of election; his powers and duties.
  - a. **Relations with Congress: 2914, 860.**
  - b. **Veto Power: 3636.**
  - c. **Treaty-Making Power: 3529.**
- B. **The Vice-President: 3636.** Since the Vice-President's chief duty is to preside over the Senate, he is associated more properly with the Legislative than the Executive Branch.
- C. **The Cabinet: 555.** The President's advisers and heads of the ten great executive departments
- D. **The Executive Departments: 3596.**
  - a. **State Department—Organization and Duties: 3596, 3597.**
    - **1.** Diplomatic and Consular Service: 1012, 852.
    - **2.** Granting of Passports: 2691.
  - b. **Treasury Department—Its Branches and Duties: 3598, 3597.**
    - **1.** Mints and Coinage: 2258, 2281.
    - **2.** Bureau of Engraving and Printing: 2284.
    - **3.** Farm Loan Board: 1224.
    - **4.** Coast Guard (including Life-Saving Service and Revenue Cutter Service): 1995.
    - **5.** Public Health Service: 1612.
  - c. **War and Navy Departments: 3598, 3597.** Organization of Army: 217, 2236; Navy: 2426, 2418.
  - d. **Postoffice Department: 2893, 3599, 3597.**
  - e. **Department of Commerce and Its Varied Duties: 3599, 3597.**
    - **1.** Bureau of Lighthouses: 2006.
    - **2.** The Bureau of Census: 676.
    - **3.** The Bureau of Fisheries: 1280, 1282.
    - **4.** Bureau of Mines: 2251.
    - **5.** Patent Office: 2694, 884.
  - f. **Department of Agriculture and Its Functions: 3600, 3597.**
    - **1.** Weather Bureau: 3707.
    - **2.** Bureau of Public Roads: 3026.
    - **3.** Forest Service: 1331, 1329.

- g. **Department of Labor: 3600, 3597.**
- h. **Department of the Interior: 3600, 3597.**
  - **1.** General Land Office: 1960.
  - **2.** Office of Indian Affairs: 1774.
  - **3.** Bureau of Pensions: 2722.
  - **4.** Bureau of Education: 1086, 77.
  - **5.** Reclamation Service: 1829.
  - **6.** National Park Service: 2399.
- i. **Department of Justice: 3601, 3597.**

E. Civil Service: 774.

F. Independent Executive Branches: Besides the ten departments there are various independent Commissions and Bureaus which belong to the Executive Branch of the Government, such as the **Government Printing Office 3601; Civil Service Commission 776; Interstate Commerce Commission 1794; Federal Reserve Board 1230.**

VII. JUDICIAL BRANCH: The branch which applies and interprets the laws.

- **A. Courts of Justice: 909.** Their criminal and civil functions; different classes of courts.
  - a. **Habeas Corpus: 1557.**
  - b. **Jury Trials: 1903.**
  - c. **Prisons and Punishments: 2918.**
  - d. **Juvenile Courts: 1906.**
- **B. The Judiciary of the United States Government: 909, 3594, 2155.** The United States Supreme Court and its jurisdiction; inferior courts; courts martial.
- **C. The British Court System: 909.**

VIII. TAXATION: 3440. How a government obtains money to conduct its affairs; how a tax is levied; different kinds of taxes.

IX. STATE GOVERNMENT IN THE UNITED STATES: 3346. Besides the elaborate machinery that goes to make up the Federal Government, each State has an independent organization limited only by the Federal Constitution.

- **A. Relations between the State and Federal Governments:**
  - a. **States' Rights: 3347.**
  - b. **Powers Given the States by the Federal Constitution: 3593.**
  - c. **Power of United States Supreme Court over State Laws: 3594.**
- **B. Bill of Rights: 393.** The portion of a State Constitution which defines the rights of the individual.
- **C. Important Departments and Functions of State Government:**
  - a. **State Courts: 909.**
  - b. **State Health Department: 1612.**
  - c. **State Constabularies: 2866.**
  - d. **Control of Public Education: 1086, 830, 3142.**
  - e. **Control of Corporations: 893.**
  - f. **Public Utilities Controlled by the State: 2932.**

X. LOCAL GOVERNMENTS IN THE UNITED STATES:

- **A. The County and Its Organization: 906.**
- **B. Township or Town Government: 3521, 3008.** A government unit that survives from the days of the Puritan Fathers and is still a political entity in some states.
- **C. Municipal Government: 2370.** Village and city charters; how the government is organized; different types of city government.
  - a. **Relations between the City and the State: 770.**
  - b. **Important Departments:**
    - **1.** Fire Department: 1257.
    - **2.** Health Department: 1612.
    - **3.** Police Department: 2865.
    - **4.** Police or Municipal Courts: 909.
  - c. **Regulation of Public Utilities: 2932.**
  - d. **Borough System of Government in New York City: 2498.**

XI. POLITICAL PARTIES AND ELECTIONS:

- **A. Political Parties: 2869.** The origin and necessity of parties in the governments of free peoples.
- **B Suffrage: 3384.**
  - **—Woman Suffrage: 3777.**
- **C. Elections: 1107.**
  - a. **Voting by Ballot: 320.**
  - b. **Primary Elections in the United States: 2915.**
- **D. Initiative, Referendum, and Recall: 1778.**

XII. INTERNATIONAL LAW: 1794.

- **A. Treaties: 3529.**
  - a. Naturalization Treaties: 2405.
  - b. International Postal Union: 2898.

For additional information on topics mentioned in these Outlines

- B. Arbitration of Disputes: 172.
- C. Extra-Territorial Rights of Diplomatic Representatives: 1013.
- D. Some Rules of War: 1794.
  - a. Blockade: 437.
  - b. Embargo Acts: 1140.
  - c. Privateering and Letters of Marque: 2810.
  - d. Armistice and Truce: 213.
- E. Hague Peace Conferences: 1559.
- F. League of Nations: 1974.

Education

Note: This Outline is intended only as a brief survey of the principal articles on educational subjects. A full discussion of the modern educational movements and of educational theory from the point of view of American schools will be found in the Outline devoted to the Problem Project Method and allied topics.

- I. PSYCHOLOGY AND ITS IMPORTANCE IN EDUCATION: 2930.
  - A. The Mind Defined: 2247.
  - B. Apperception and Its Relation to Methods of Learning: 158.
  - C. Memory—What It is and How It May Be Improved: 2197.
  - D. Habits and How They are Formed: 1557.
  - E. Adolescence: 25. How the intellect is affected by the period of transition from childhood to adult life.
  - F. Intelligence Tests as a Guide to Ability: 1793.
- II. SOME SPECIAL EDUCATIONAL THEORIES AND METHODS:
  - A. The Training of Young Children: 729.
    - a. Froebel and the Kindergarten: 1923, 1372.
    - b. Montessori Method: 2313.
    - c. Importance of Play: 2832.
  - B. Vocational Education: 3653.
  - C. The Gary School Plan: 1401.
  - D. Methods of Educating the Blind and Deaf: 436, 970.
  - E. Athletics as a Part of the Education of Youth: 251.
  - F. The Use of Motion Pictures as a Means of Instruction: 2342.
  - G. Story Telling as an Aid to Education: 3367.
  - H. Methods of Study: 3372.
    - a. The Study of Grammar as a Basis for Correct Thinking: 1495.
    - b. Mind Training Through Reading: 2979.
    - c. School Gardens as an Aid to Various Branches of Study: 3142.
- III. EDUCATIONAL AGENCIES:
  - A. School Systems in the United States and Other Countries: 3138. Classes of schools; vacation schools; commercial and industrial schools; continuation schools; some important educational problems in the United States.
    - a. History of Public Education in the United States: 1084.
    - b. Some Special Types of School in the United States:
      - 1. Vocational schools and classes: 3655.
      - 2. Schools for the blind and for the deaf: 437, 970.
      - 3. Schools for negroes: 2434, 73.
  - B. Colleges and Universities: 827. Courses of study; value of a college education; requirements for entrance; classes of colleges in the United States; junior colleges; extension departments; the development of the university; important universities of Europe, Canada, and the United States.
  - C. Auxiliary Institutions and Organizations for Educational Purposes:
    - a. Libraries and How To Use Them: 1991.
    - b. The Chautauqua Movement: 707.
    - c. Social Settlements: 3269.
    - d. Boy Scouts, Girl Scouts, and Camp Fire Girls: 479, 1464, 592.

Social Science Books for Young Readers

Around the World with the Children. F. G. Carpenter.
Home Life Around the World. George A. Mirick.
Curiosities of Popular Customs. W. S. Walsh.
How Other People Live. H. C. Barnard.
Cave, Mound, and Lake Dwellers. Florence Holbrook.
Romance of Savage Life. G. F. Scott Elliot.
Strange Peoples. Frederick Starr.
Short History of Coins and Currency. Sir John Lubbock.
Uncle Sam's Business. Crittenden Marriott.
Uncle Sam's Modern Miracles. William A. Du Puy.
The Friendship of Nations. Lucile Gulliver.
Politics for Young Americans. Charles Nordhoff.
What to Do for Uncle Sam. Carolyn Sherwin Bailey.
Course in Citizenship. Mrs. Ella Cabot.
The American Citizen. C. F. Dole.
The Progress of a United People. C. L. Barstow.
Lessons for Junior Citizens. Mabel Hill.
Among the Law-Makers. Edmund Alton.
Century Book for Young Americans. E. S. Brooks.
How the Republic is Governed. Noah Brooks.
How the People Rule. Charles De Forest Hoxie.
Elements of Civil Government. W. A. Mowry.
Nation and State. G. M. Philips.
Young Citizen's Reader. Paul S. Reinsch.

Social Science Books for Older Readers

SOCIOLOGY

Introduction to the Study of Sociology. E. C. Hayes.
The Elements of Sociology. F. H. Giddings.
An Introduction to the Study of Society. A. W. Small and G. E. Vincent.
The Mind of Primitive Man. Franz Boas.
Biological Aspects of Human Problems. C. A. Herter.
Primitive Culture. E. B. Tylor.
Men of the Old Stone Age. Henry Fairfield Osborn.
Ethnology. A. H. Kean.
Prehistoric Man and His Story. G. F. Scott Elliot.
Savage Survivals. J. Howard Moore.
Ancient Law, Its Connection with the Early History of Society and Its Relation to Modern Ideas. Sir Henry Mayne.
The Golden Bough. J. G. Frazer.
The History of Social Development. F. Müller-Lyer.
Ancient Society. Lewis H. Morgan.
Influences of Geographic Environment. Ellen Churchill Semple.
The Material Culture and Social Institutions of the Simpler Peoples. L. T. Hobhouse.
Primitive Society. Robert H. Lowie.
Origin of Civilization and the Primitive Condition of Man. Sir John Lubbock.
Social Origins and Primal Law. Andrew Lang and J. J. Atkinson.
The Development of Western Civilization. J. D. Forrest.
The Anatomy of Society. Gilbert Cannan.
Principles of Sociology. Herbert Spencer.
Theory of Social Forces. S. N. Patten.
Social Control. E. A. Ross.
Sociology: Its Simpler Teachings and Applications. James Q. Dealey.
Sociology and Modern Social Problems. C. A. Ellwood.
An Introduction to Social Psychology. C. A. Ellwood.
Social Evolution and Political Theory. L. T. Hobhouse.
Theories of Social Progress. A. J. Todd.
Individual and Society; or Psychology and Sociology. J. M. Baldwin.
Sociology Applied to Practical Politics. J. B. Crozier.
The Meaning of Social Science. A. W. Small.
Social Institutions. D. J. Snider.
Applied Sociology. L. F. Ward.
Evolution and Ethics. T. H. Huxley.
Democracy and Social Ethics. Jane Addams.
Social Environment. George R. Davies.
A History of the Family as a Social and Educational Institution. Willystine Goodsell.
The Spirit of Youth and the City Streets. Jane Addams.
The State and the Child. W. Clarke Hall.
Parents and Their Problems. Mary Harmon Weeks.
Outlines of Child Study. William A. McKeever.
The Origins of Popular Superstitions and Customs. T. S. Knowlson.
Holiday Facts and Fancies. C. J. Denton.

Note: Additional books dealing with many practical phases of Sociology will be found with the Outlines on Geography and Home Economics.

ECONOMICS

Wealth of Nations. Adam Smith.
Principles of Political Economy and Taxation. David Ricardo.
Principles of Political Economy. T. R. Malthus.
Principles of Political Economy. J. S. Mill.
Principles of Political Economy. Henry Sidgwick.
Capital: A Critique of Political Economy. Karl Marx.
Outlines of Economics. R. T. Ely.
Progress and Poverty. Henry George.
Elementary Principles of Economics. Irving Fisher.
Philosophy of the Practical. Benedetto Croce.
Principles of Economics. E. R. A. Seligman.
Taxation and the Distribution of Wealth. Frederick Mathews.
Principles of Economics. F. W. Taussig.
History of Economic Thought. L. H. Haney.
Value and Distribution. H. J. Davenport.
Labor Problems. T. S. Adams and H. L. Sumner.
Economic History of United States. E. L. Bogartt.
Tariff History of United States. F. W. Taussig.
Introduction to Public Finance. C. C. Plehn.
Money and the Mechanism of Exchange. W. S. Jevons.
The Rate of Interest. Irving Fisher.
The Principles of Money and Banking. C. A. Conant.
Money, Banking, and Finance. A. S. Bolles.
The Value of Money. Benjamin M. Anderson.
Commercial Paper; a Text Book for Merchants, Bankers, and Investors. Roger W. Babson and Ralph May.
The Practical Work of a Bank. W. H. Kniffin.
Foreign Exchange Explained. Franklin Escher.
The Elements of Insurance. J. A. Eke.
Insurance Science and Economics. F. L. Hoffman.
Principles of Insurance. W. F. Gephart.
Insurance and the State. W. F. Gephart.
Labor, Management, and Production. Compiled by the American Academy of Political and Social Science.
Trade Unionism and Labor Problems. J. R. Commons.
The Financial Organization of Society. H. G. Moulton.
Banking Practice. L. H. Langston and N. R. Whitney.
The Stock Exchange. F. W. Hirst.
The Evolution of Industry. D. H. Macgregor.
The Factory. J. T. Lincoln.
Capitalization; a Book on Corporation Finance. W. H. Lyon.
Organizing a Business. Maurice H. Robinson.
Business a Profession. Louis D. Brandeis.
Trusts, Pools, and Corporations. W. Z. Ripley.
Money and Prices. J. Laurence Laughlin.
Coöperation and the Future of Industry. Leonard S. Woolf.
Profit-Sharing; Its Principles and Practice. Boris Emmet.
The Conditions of Labor in the American Industries. W. J Lauk and Edgar Sydenstriker.
Economic History of the United States. E. L. Bogart.
Elements of Commercial Law. A. H. Douglas.

POLITICAL SCIENCE

The Spirit of Laws. Montesquieu.
Plato's Republic.
The Social Contract. Rousseau.
The Political Theories of the Ancient World. W. W. Willoughby.
Theory of the State. J. K. Bluntschli.
Elements of Politics. Henry Sidgwick.
Introduction to the History of the Science of Politics. Sir Frederick Pollock.
History of American Political Theories. C. E. Merriam.
Problems in Political Evolution. R. G. Gettell.
The Citizen. N. S. Shaler.
The Promised Land. Mary Antin.
New Civics. R. L. Ashley.
American Citizenship. C. A. and M. R. Beard.
The Constitution and What It Means Today. Edward S. Corwin.
Immigration and Americanization. Philip Davis and Bertha Schwartz.
Organized Self-Government. Edgar Dawson.
Advanced Civics. S. E. Forman.
Undercurrents in American Politics. A. T. Hadley.
Community Civics. R. O. Hughes.
Conservative Democracy. Paul Kester.
The American Commonwealth. James Bryce.
Modern Democracies. James Bryce.
Governments and Parties in Continental Europe. A. L. Lowell.
The Initiative, Referendum, and Recall in America. E. P. Oberholtzer.
American Legislation and Legislative Methods. Paul S. Reinsch.
The Rights and Duties of American Citizenship. W. W. Willoughby.
Popular Law-Making. F. J. Stimpson.
Parliamentary Law and Practice. L. S. Cushing.
Local Government in Counties, Towns, and Villages. J. A. Fairlie.
The Government of American Cities. W. B. Munro.
The Government of European Cities. W. B. Munro.
Police Administration. L. F. Fuld.
Law and Its Administration. Harlan F. Stone.
The American Judiciary. S. E. Baldwin.
Treatise on Criminal Law and Criminal Procedure. C. E. Chadman.
Juvenile Courts. Stanley K. Hornbeck.
International Law. Berthold Singer.
International Law. G. G. Wilson and G. F. Tucker.
A Guide to Diplomatic Practice. Sir Ernest Satow.

EDUCATION AND PSYCHOLOGY

A General Introduction to Psycho-Analysis. Sigmund Freud.
Psychology of the Unconscious. Carl Gustav Jung.
The Theory of Psycho-Analysis. Carl Gustav Jung.
Psycho-Analysis and Behavior. André Tridon.
Psycho-Analysis, Sleep, and Dreams. André Tridon.
An Introduction to Social Psychology. Charles Abram Ellwood.
Mind in the Making. Edgar J. Swift.
Memory. Hermann Ebbinghaus.
Educational Psychology. Edward L. Thorndike.
Talks to Teachers on Psychology and to Students on Some of Life's Ideals. William James.

Principles of Psychology. William James.
How We Think. John Dewey.
Psychology of the Common Branches. Frank N. Freeman.
The Child's Unconscious Mind. Wilfrid Lay.
Character Training in Childhood. Mary S. Haviland.
The Psychology of Adolescence. Frederick Tracy.
The Intelligence of School Children. Lewis M. Terman.
Methods and Results of Testing School Children. Dewey, Evelyn, and Others.
Educational Tests and Measurements. Monroe, DeVoss, and Kelley.
Mentally Defective Children. Binet and Simon.
History of Education. Paul Monroe.
A History of Education During the Middle Ages and the Transition to Modern Times. F. P. Graves.
The Educative Process. William C. Bagley.
Emile, or Concerning Education. Jean-Jacques Rousseau.
Democracy and Education. John Dewey.
Changing Conceptions of Education. E. P. Cubberley.
American Education. A. S. Draper.
The Child and the Curriculum. G. Stanley Hall.
Youth; Its Education, Regimen, and Hygiene. Paul H. Hanus.
History of Common School Education. L. F. Anderson.
The School. J. J. Findlay.
Jean-Jacques Rousseau and Education from Nature. Gabriel Compayré.
The Education of Man. Friedrich W. A. Fröbel.
The Montessori Method. Maria Montessori.
Montessori Methods in a Large Infants' School. Mary Blackburn.
Learning to Earn. John A. Lapp and Carl H. Mote.
Introduction to Vocational Education. David Spence Hill.
The Vocational Guidance Movement, Its Problems and Possibilities. John M. Brewer.
Educational Extension. Clarence Arthur Perry.
The Principles and Practice of Continuation Teaching. Charles H. Kirton.
Business and Education. Frank A. Vanderlip.
The Junior High School. Leonard V. Koos.
Present Standards of Higher Education in the United States. G. E. MacLean.
College Entrance Requirements. C. D. Kingsley.
The Story of Chautauqua. Jesse Lyman Hurlbut.
Motion Picture Education. Ernest A. Dench.
Teaching Citizenship Via the Movies. Ina Clement.
How to Tell Stories to Children. S. C. Bryant.

HOME ECONOMICS

THE study of Home Economics, which deals with the natural, economic, and social foundations of home-life, has come to have an important place in general education. The four main topics of which it treats are shelter, food, clothing, and home management. The article on Home Economics (1675) tells something of the scope of the subject as it is taught in the schools. In this Outline there are gathered together the chief articles and portions of articles which will be of assistance to anyone interested in the art of home-making.

I. THE HOME AND ITS EQUIPMENT:
- **A. Heating and Ventilation: 1621, 1715.** Importance of Keeping a House at the Proper Temperature; Different Heating Systems; How to Keep the Air Fresh.
    - **—Stoves and Fireplaces: 3368.**
- **B. Lighting Systems: 1958.**
    - **a. Electric Lighting: 1123.**
    - **b. Gas Lighting: 1406.**
    - **c. Acetylene Lighting: 7.**
    - **d. Gas and Electric Meters: 2204.**
- **C. Plumbing and Sewerage: 2840, 3182, 1715.**
    - **—Water Meters: 2206.**
- **D. Locks and Keys: 2042.**
- **E. Furnishings and Decoration:**
    - **a. Wall Coverings: Wall Paper 3665; Tapestry 3433.**
    - **b. Rugs and Carpets: 3077.**
    - **c. Furniture: 1383.** Veneer 3620.
    - **d. Baskets and Pottery: 341, 2903.**
    - **e. Paints and Varnishes: 2642.**
- **F. Electrical Labor-Saving Devices: 1114.**

II. SANITATION, VENTILATION, AND HYGIENE:
- **A. Keeping the Home in Sanitary Condition: 1715.** House Cleaning; Care of Food; Keeping the Drinking Water Pure; Heat and Ventilation.
    - **a. Insect Pests and How to Destroy Them:** Flies 1312; Cockroaches 817; Fleas 1292.
    - **b. Mice and Rats: 2359, 2978.**
    - **c. Fumigation and Disinfectants: 151, 1331.**
    - **d. Mildews and Molds and How to Avoid Them: 2235.**
- **B. Personal Hygiene:**
    - **a. How to Keep Fit: 1713.**
    - **b. First Aid: 1266.** What to Do Till the Doctor Comes; Treatment of Common Mishaps; What to Keep in a First Aid Box.
- **C. Fire Prevention: 1260.**

III. FOOD: 1320.
- **A. Food Materials:**
    - **a. Carbohydrates: Starches 3344; Sugars and Their Food Value 3388.**
    - **b. Fats: 1225.**
    - **c. Proteins: 2926.**
    - **d. Mineral Salts—How They are Absorbed by Plants and Passed on to Man: 2824.**
    - **e. Vitamins: 3651.**
    - **f. Water: 3694.**
- **B. Some Important Foods:**
    - **a. Meat and Meat Packing 2180; Cuts of Beef 2185.**

b. **Principal Food Fishes: 1278.**
c. **Eggs—Their Value and How to Preserve Them: 2908.**
—Varieties of Eggs Used as Food: 1090.
d. **Milk and Its Products: 2238.** Dairying 949; Cheese 708; Butter 543.
e. **Grain Foods:** Breakfast Cereals 501; Flour 1301; Wheat 3730; Corn and Hominy 890; Barley 330; Rice 3015; Buckwheat 524.
f. **Legumes or "Pod" Foods:** Beans 347; Peas 2698; Lentils 1988; Peanuts 2700.
g. **Root, Bulb, and Tuber Foods:** Radishes 553; Turnips 554; Beets 365; Parsnips 2691; Carrots 650; Onions 2581; Potatoes 2900; Sweet Potatoes 3405.
h. **Leaf and Stalk Foods:** Cabbages and Cauliflower 553; Asparagus 234; Celery 671; Lettuce; Spinach; Rhubarb 3012.
i. **Other Vegetables:** Tomatoes 3512; Cucumbers 939; Pumpkins and Squash 2934, 3333.
j. **Fruits: 1377, 1380; Melons 2195; Nuts 2545.**
k. **Foods Used for Their Taste or Flavor:** Sugar 3385; Maple Sugar 2138; Spices and Condiments 3317; Pepper 2723; Salt 3115.

C. Cooking: **875.** Soups; Meats; Eggs; Cakes; Muffins; Pancakes.
a. **Use of Baking Powder: 305.**
b. **Bread and Baking: 496.**
c. **Candies: 628.**
d. **Camp Cooking: 599.**

D. Preservation of Food: **151.**
a. **Cold Storage and Refrigeration: 825, 2989.**
b. **Dehydration, or the Process of Drying Fruits and Vegetables: 986.**
c. **Canning: 631.**
d. **Pure Food Laws: 2936.**

E. **Some Pointers about Table Setting and Table Manners: 1183.**
—History of the Use of Knives, Forks, and Spoons: 1937.

IV. CLOTHING:
A. **The History of Costume: 897.**
B. Textiles:
a. **Kinds of Cloth: 804.** Cotton 904; Linen 2018, 1291; Silk 3234; Wool 3782.
b. **Spinning, Weaving, and Knitting: 3326, 1935.**
c. **Bleaching and Dyeing: 435, 1049.**
C. **How Clothing is Manufactured: 805.**
a. **Hats and Caps: 1597.**
b. **Shoes: 3220.**
c. **Gloves: 1474.**
d. **Buttons: 548.**
D. **Sewing and Mending: 3183.**
a. **Sewing Machines and How They Work: 3186.**
b. **Needles and Thread: 2433, 3493.**
c. **Embroidery: 1140.**
E. **How Clothing is Handled in the Modern Laundry: 1969.**

V. CARE OF CHILDREN:
A. **Baby Care: 291.**
B. **Child Training: 729.**

VI. DOMESTIC PLANTS AND ANIMALS:
A. **Gardens and Gardening: 1394.**
a. **What and When to Plant in the Vegetable Garden: 1397.**
b. **Hedges: 1627.**
c. **How to Fight Weeds: 3713.**
Note: For additional information on gardening, read the articles on the various garden flowers and plants.
B. **Pets and Their Care: 2755.**
—Birds and Bird Houses: 421.

VII. HOW TO KEEP HOUSEHOLD ACCOUNTS: **5.**

Books on Home Economics

FOR YOUNG READERS

How the World is Housed. Frank George Carpenter.
Home Decoration. Charles Franklin Warner.
How to Make Baskets. Mary White.
More Baskets and How to Make Them. Mary White.
Carpentry and Woodwork. Edwin W. Foster.
Health in Home and Town. Bertha Millard Brown.
Saturday Mornings or How Margaret Learned to Keep House. Caroline Benedict Burrell.
Housekeeping for Little Girls. Olive Hyde Foster.
Book of Useful Plants. Julia Ellen Rogers.
Little Cook Book for a Little Girl. Caroline Benedict Burrell.
When Mother Lets Us Cook. Constance Johnson.
Six Little Cooks, or Aunt Jane's Cooking Class. Elizabeth Stansbury Kirkland.
Sewing for Little Girls. Olive Hyde Foster.
Needlecraft. Effie Archer.
When Mother Lets Us Sew. Virginia Ralston.

The Little Girl's Sewing Book. Flora Klickmann.
When Mother Lets Us Garden. Frances Duncan.
Gardening for Little Girls. Olive Hyde Foster.
The Book of the Home Garden. Edith Loring Fullerton.
Forty Lessons in Gardening. United States Education Bureau.
Hints and Helps for Young Gardeners. Herbert Daniel Hemenway.
The Pet Book. Anna Botsford Comstock.
Bird Houses and How to Build Them. Ned Dearborn.

FOR OLDER READERS

The Home Economics Movement. Bevier and Usher.
Syllabus of Home Economics. American Home Economics Association, Baltimore, Md.
The Art of Right Living. E. H. Richards.
Household Arts for Home and School (2 vols). Anna M. Cooley and Wilhelmina H. Spohr.
The Science of Home Making. Emma E. Pirie.
1000 Shorter Ways Around the House. Mae Savell Croy.
The Home and Its Management. Mabel Hyde Kittredge.
The New Interior. Hazel H. Adler.
The Practical Book of Interior Decoration. Horace Donaldson Eberlein and others.
Color Schemes for the Home and Model Interiors. Frohne and Jackson.
Interior Decoration for the Small Home. Amy L. Rolfe.
Historic Styles in Furniture. Virginia Robie.
Antique Furniture. Frederick W. Burgess.
Handbook of Furniture Styles. Walter A. Dyer.
Decorative Textiles. George Leland Hunter.
Making Curtains and Hangings. Agnes Foster.
Old Pottery and Porcelain. Frederick W. Burgess.
Letters to a Young Housekeeper. Jane Prince.
Food Facts for the Home Maker. Lucile Stimson Harvey.
Food and Health. Helen Kinne and Anna M. Cooley.
The Planning of Meals. Isabel Bevier.
Balanced Meals with Recipes. Lake View Woman's Club, Chicago.
Low Cost Cooking. Florence Nesbitt.
Home Canning, Drying, and Preserving. A. Louise Andrea.
How to Set the Table for Every Occasion. Sara Swain Adams.
The Service of Meals. Nina B. Crigler.
The Psychology of Dress. Frank Alvah Parsons.
Textiles and Costume Design. Evelyn Peters Ellsworth.
The Art and Ethics of Dress as Related to Efficiency and Economy. Eva Olney Farnsworth.
Clothing and Health. Helen Kinne and Anna M. Cooley.
Clothing for Women. Laura I. Baldt.
Costume Design and Home Planning. Estelle Peel Izor.
A Handbook of Elementary Sewing. Etta Procter Flagg.
The Health Care of the Growing Child. Louis Fischer.
Infancy and Childhood. Walter Reeve Ramsey.
The Care and Feeding of Children. Emmett Holt, M.D.
The Care of the Baby. J. P. C. Griffith, M.D.
Around the Year in the Garden. Frederick F. Rockwell.
Studies in Gardening. Arthur Clutton Brock.
House Plants. Hugh Findlay.
Continuous Bloom in America. Louise Shelton.
The Backyard Garden. Edward I. Farrington.
Practical Gardening. Hugh Findlay.
Pets. Lee S. Crandall.

Note: Many additional books on handicrafts and similar topics of interest to home-makers, young and old, will be found with the Outline on Industries and Applied Science.

Picture Story of Dress

The Rude Garments of Our Cavemen Ancestors 666-7.
Simple Dress of the Egyptians 1101-2.
Assyrian Soldier in Armored Mail 296.
The Classic Costumes of the Greeks and Romans 1526, 1516, 3542, 3041.
Byzantine Ladies in Court Costume 2630.
Royal Robes of England's Rulers 1429.
Uniform of the London Policeman 2053.
Gipsy Children 1463.
A Scotch Highlander in Plaid and Bonnet 3146.
The Frock of an Irish Lass 1807.
Costumes of Rural France 1347-50.
A Belgian Milkmaid 374.
The Suit of a Swiss Boy 1476.
Costume of a Swiss Peasant 3413.
Dress in the Land of the Dutch 2439.
Rich Costumes of Dutch Royalty 2636.
Quaint Costumes of Bavaria 346.
Danish Peasant Dress 994.
The Costumes of Old and Young Icelanders 1723-4.
National Dress of the Swedes 3402.
Some Styles Seen in Norway 2530-5.
Dress of the Polish Peasants 2856-8.
A Rumanian Working Woman 3081.
A Rumanian Bridal Dress 3082.
Holiday Dress of the Rumanian Peasant 273.
The Royal Apparel of a Young Spanish Prince 2636.
Street Dancers of Granada in Their Spanish Frocks 3299.
Gorgeous Trappings of the Spanish Matador 3305.
The Suit of a Spanish Workman 3300.
Portuguese Housewives 2889.
Italian Costumes 1838-41.
Fashions in the Balkans 309, 1902.
Types of Russian Dress 3085-9.
A Russian Coachman in His Padded Livery 2748.
Egyptian Water Carriers 1093, 566.
Garments of an African Arab 1685.
Moslem Dress 2328.
Court Costumes of Abyssinia 3.
Ceremonial Dress of East Africans 1068.
African Royal Dress 33.
African Styles 35, 38.
Garments of the Zulus 3280-3.
Simple Dress Worn by the Natives of Madagascar 2105.
Four Types of Asiatic Dress 227.
Kimonos of the Japanese 1862-75.
Korean Clothes 1942.
Chinese Costumes 742-51, 638, 2708.
The Heavy Garments of the Tibetans 3496, 231.
Gown of a Siamese Dancer 3227.
Native Dress in the Malay Peninsula 2129-31.
Singapore Workmen 2723.
Varied Styles of India 1746-52, 1756.
Curious Persian Costumes 2734-5.
Modern Styles of Arabia 166.
White-Clad Arab Worshipers 2275.
Armenian Dress 212.
Syrian Styles 955-6, 3425.
Turkish Costumes 3558-60.
Odd Costumes Seen on the Shores of the Tigris 2200.
Jewish Costumes of Jerusalem 1886.
Official Dress in Java 1879.
Dress in the Philippines 2765-9.
Garments of Spice Workers 3318.
Native Dress in New Guinea 2451.
The "Full Dress" of a Native Australian 262.
New Zealand Styles 2499.
Fashions of the South Seas 2618-24, 819.
Hawaiian Dress 3386.
Costumes of the Greenlanders 1539.
The Navajo Indians and Their Blankets 206.
Typical Dress of the Pueblo Indians 2933.
Costumes of the American Indians 1765-70.
Some Native Mexicans 2209-15.
Garments of Jamaica 1860.
Costumes Seen in the Streets of Haiti 1561.
Dress of the Peruvian Forest 2741.
Various Styles of South America 3287.
Our Puritan Ancestors Dressed for Church 2937.
Uniforms of the Revolutionary War 3000-3.
The Blue and the Gray of the Civil War 776-8.
Civil War Uniforms of the Federal Generals 2015.
Uniform of the United States Soldier 217.
The American Sailor in Uniform 2425, 3378.
American Army and Navy Uniforms and Insignia 3576-7.
Modern Fireman's Uniform and Equipment 1260.
Dress in Eskimo Land 1176-7.
Warm Garments of the Polar Explorers 120, 2862, 2704.
Various Uniforms and Equipment of the World War Soldiers 3789-3809.
Uniform of a Belgian Sentry in the World War 3790.
French Marshal's Uniform 1315.
Evolution of Dress 897-900.
Styles in Armor 215.
Monastic Dress 2298-2302.
Police Uniforms in Many Lands 2865-8.
Postmen's Uniforms in Various Parts of the World 2892-4.
Fashions in Diving Clothes 1014, 2782.
Boy Scout's Uniform 479-483.
Ceremonial Dress of the Camp Fire Girl 592.

Picture Story of Houses

A Reconstructed House from the Ruins of Pompeii 2877.
Plan of a Medieval European Castle 655.
A Farm House in the Hills of Norway 2533.
A Typical English Thatched Cottage 1155.
Old Timbered Houses of Chester, England 1157.
An Irish Peasant's Cottage 1808.
Cottages of the Scottish Villager 2345.
A German Peasant's Cottage in the Black Forest 1439.
Goethe's Birthplace, Frankfort-on-the-Main 1478.
A Typical Hungarian Farm House 1703.
Peasant Home, Austria-Hungary 272.
A Peasant's House in the Portuguese Mountains 2891.
Some Dwellings in the Balkans 309.
The Thatched Hut of a Caucasus Peasant Family 3087.
Mushroom Huts of South Africa 38.
A "Walled City" in British East Africa 37.
Beehive Huts in Zululand 3280.
Simple Cottages of Remote Siberia 3228.
Hat-Like Dwellings of Korea 1943.
Stone Houses of the Hill Tribes of India 1650.
Indian House on the Slopes of the Himalayas 1745.
Picturesque Houses of Modern India 1746.
Chinese Life in Walls of Mud 745.
The Famous Tile Roofs of China 743.
Modern Chinese Houses Show European Influence 750.
The American Consulate at Mukden, China 747.
Village Homes in Siam 3227.
New Guinea Tree Dwellings 2452.
A Native's Hut in the Philippines 2766.
Samoan Basket-Work Hut 2623.
A Samoan Schoolhouse 3120.
A Maori Home—New Zealand 2499.
Interior of a Native House of Southern Chile 736.
Native Huts of Panama 2649.
Architecture of the Incas 1741.
American Indian Tepees 1764.
Indian Architecture at Its Best 1774.
Hopi Indians, Southwestern United States 1766, 1769.
Ruins of a Three-Story Cliff-Dwelling in Colorado 793.
Ruins of a Cliff-Dwelling in Arizona 205.
First Homes of the Pilgrims at Plymouth 2842.
Colonial Home of William Penn, Philadelphia, 2761.
Home of Miles Standish 2842.
A Home of Early Chicago 722.
A Hunter's and Fur Trapper's Cabin in Northern Canada 1389.
Winter Quarters in Eskimo Land 1175.

Note: For pictures of great buildings consult the list in the Outline on Architecture.

Picture Story of Transportation

How Men Have Conquered the Earth 3525.
Some Primitive Types of Water Craft 443.
Ancient Egyptian Chariots 1103.
The Chariot of Ancient Rome 3040.
The Famous Irish Jaunting Car 1809.
Rural Ireland's Typical Donkey Cart 1807.
The Dogs that Bring the Milk in Belgium 374.
A Two-Wheeled Dray in Stockholm 3403.
Spanish Mules and Their Packs 3300.
A Portuguese Peasant's Oxcart 2890.
In Italy Oxcarts Haul the Famous Carrara Marble 1838.
A Bulgarian "Taxicab" 532.
Reindeer Sleds of Snow-Bound Russia 3085.
Russian Train Crossing the Steppes 3086.
A Russian Peasant Cart 3086.
Part of Cairo's Transportation System 567.
Rickshaw with Zulu Runner of South Africa 39.
Hauling Freight in Madagascar 2105.
A Desert Caravan of Asia 233.
Low Carriage, Typical Summer Conveyance in Remote Siberia 3228.
Japanese Palanquins 1867.
A Chinese Taxi—Fare One Cent 638.
Camels, the Railway Cars of Manchuria 590.
The Yak, the Tibetan Train and Steamship 231.
A Siamese Freight Train 3227.
Camel Riders of India 1746.
Palanquins, the Fashion for Ladies in India 1747.
Covered Ox-Cart of India 3524.
The Filipino's "Auto" 2765.
An American Indian's Moving Van 1767.
American Prairie Schooners of the Old Days 584.
"Best Friend," the First American Locomotive 2963.
A "Wood-Burner" Locomotive of the 60's 2963.
Subways Relieve Traffic Congestion of New York City 2498.
Ferries on the Hudson Between New York and New Jersey 2495.
Train Being Ferried Between Detroit and Windsor, Ontario 2970.
A Logging Train on Vancouver Island 606.
One of Cuba's "Toy" Railroads 937.
The Ox Teams of Costa Rica 896.
A Double-Decked Street Car of Chile 736.
Dog Sleds Carrying Mail in the Arctics 2896.
"Huskies" of the Frozen North 1020.
The Shetland Pony of the Arctics 76.
Rivals of the Road—Steam and Electricity 2969.
Hauling Freight with Electric Power 2968.
The Car that Runs on One Rail 1555.
First Self-Propelled Vehicle to Run Along a Road 275.
The Grandfather of American Automobiles 274.
Sailing Vessels 3209.
First Great Liner 3208.
Comparison of Mayflower and Modern Ship 3207.
Launching Ships 3215.
Size of Sea Giants 3216.
The Family Tree of the Modern Balloon 315.
Flying Machine History in Pictures 57.
The First Balloon Ascension 313.
The Start of a Balloon Race at Paris 316.
Observation Balloons in the World War 317.
The First Machine to Fly Across the Atlantic 59.
Some Interesting Mechanical Birds of the United States 61.

PHYSIOLOGY, HYGIENE, and MEDICINE

A SOUND knowledge about the structure of the human body and the normal function of its various parts is an essential of modern life. Such knowledge not only encourages healthful habits, but also is a safeguard against groundless fears of disease which are often as debilitating as the disease itself. This Outline is intended merely as a brief survey of the chief parts of the body and their work, the simple laws of hygiene, and a few of the outstanding features of medical history and practice. In the Outline on Home Economics will be found a more complete survey of Foods and Food Values than has been made here. In the Outline on Biology the general laws of life are reviewed in a more scientific manner. Some aspects of Psychology which have a bearing on the formation of healthful mental habits will be found in the Outline on Education.

I. PHYSIOLOGY AND ANATOMY: **2792, 121.**
  A. Framework of the Body:
    a. Skeleton: **3244, 3634.**
    b. Composition of Bone: **452.**
    c. Hands **1571**; Feet **1322.**

- B. Muscles—How the Body is Moved: **2372.**
- C. Digestion—the Process by which the Food is Changed So that It Can be Absorbed by the Body: **1010.**
  - a. The Teeth—Preparing the Food for Digestion: **3452.**
  - b. The Stomach and How It Works: **3360.**
  - c. The Liver—the Largest Gland Organ in the Body: **2031.**
  - d. Other Glands that Aid Digestion: **1469.**
  - e. Enzymes—Chemical Substances that Aid Digestion: **1172, 2724.**
- D. Circulation:
  - a. The Blood and Its Journey Through the Body: **437.**
  - b. The Heart—the Center of the Circulatory System: **1615.**
  - c. Function of the Lungs in Circulation: **2083.**
  - d. The Pulse: **2933.**
- E. Respiration: **2998.**
  - a. The Lungs: **2083.**
  - b. The Diaphragm—the Principal Muscle of Respiration: **1005.**
  - c. The Voice and Its Organs: **3656.**
- F. Removal of Body Wastes:
  - a. Function of the Intestines: **1011.**
  - b. The Kidneys—the Filtering Plant for the Blood: **1922.**
  - c. The Sweat Glands: **3246.**
- G. Special Glands: **1469.**
- H. How the Body is Governed:
  - a. The Brain—the Executive Offices of the Body: **486.**
  - b. The Nerves—the Body's Telephone System: **2436.**
  - c. The Special Senses and Their Organs: Eye 1213; Ear 1056; Tongue and Organs of Taste 3513; Sense of Smell 3252; Touch and Temperature 3520.
- I. The Skin—the Covering of the Body: **3245.**
  - a. Hair: **1559.**
  - b. Nails: **3246, 1680.**

II. HYGIENE—THE CARE OF THE BODY: **1713.**

- A. Exercise:
  - a. Physical Training: **2784.**
  - b. Athletics: **251.**
  - c. Play for Children: **2832.**
- B. Food—What to Eat to Build Healthy Bodies: **1320.**
  - a. Protein and the Foods Which Contain Them: **2926.**
  - b. Vitamins—Mysterious Food Substances Essential to Proper Growth and Preservation of the Body: **3651.**
- C. The Value of Sleep: **3250.**
- D. Sanitation and Ventilation:
  - a. Personal Cleanliness: **1713, 1452.**
  - b. Sanitation in the Home: **1715, 1675.**
  - c. Heating and Ventilation: **1621.**
  - d. Uses of Antiseptics: **151.**
- E. Baby Care: **291.**
- F. Public Health:
  - a. Health Department: **1612.**
  - b. Plumbing and Sewerage: **2840, 3183.**
  - c. Waterworks: **3701.**
  - d. Pure Food Laws: **2936.** Meat Inspection 2182; How the Dairyman Keeps Milk Pure 952.

Note: Additional information on Hygiene is contained in many of the articles on the different parts and organs of the body listed in Section I, and in the following section on Medicine and Surgery.

III. MEDICINE AND SURGERY: **2192.**

- A. Germ Theory of Disease: **1449.**
  - a. Bacteria: **302.**
  - b. Protozoa: **2927.**
- B. Disease Carriers:
  - a. Mosquito—the carrier of Malaria and Yellow Fever: **2334, 2651.**
  - b. Flea—the Bubonic Plague Carrier: **1292, 433.**
  - c. Tsetse Fly—the Insect which Produces the Dreaded Sleeping Sickness: **3546.**
  - d. House fly—Carrier of Typhoid Fever, Tuberculosis, and Many Other Diseases: **1312.**
- C. Other Disease Parasites: Worms (3813), including the Hookworm (1679), the Filaria, a cause of Elephantiasis; the Trichina, producer of Trichinosis; the Tapeworm; and others.
- D. Prevention and Treatment of Disease:
  - a. Antitoxins and Serums: **151.**
    - **1.** Vaccination: 3613.
    - **2.** Pasteur's work: 2692.

- b. **Surgery: 2193.**
  - 1. Anesthetics: 124.
  - 2. Use of Antiseptics: 150.
  - 3. Use of the X-Ray and Radium: 3824, 2958.
- c. **Drugs: 1041.** Among the common drugs are Ammonia compounds 118; Arsenic 220; Atropin 2509; Camphor 594; Carbolic Acid 641; Eucalyptol 1186; Formaldehyde compounds 1331; Iodine 1802; Calomel and other Mercury Compounds 2200; Opium compounds (Laudanum, Morphine, Heroin) 2584; Pennyroyal and Menthol 2257; Quinine 2950; Silver compounds 3242; Strychnine and Nux Vomica 3372; Witch-Hazel 3774.

  Note: Many of the common drugs improperly used are poisons. For a list of the principal poisons and their antidotes read the articles on Poisons and First Aid (1270, 2854).
- d. **Osteopathy: 2603.**
- e. **Dentistry: 997.**

E. Auxiliary Medical Agencies:

- a. **Hospitals: 1687.**
- b. **Nursing and First Aid: 2544, 1266**

Picture Aids in Physiology and Hygiene

Picture Studies of Our Body Machinery 2793-6.
The Marvelous Framework of the Body 3244.
The Great Brotherhood of the Backbone 3245.
The Three Types of Heads 2956.
The Control Station of Your Body 487.
How the Artist's Brain Paints a Picture 489.
Chief Parts of the Brain 490.
The Inside of the Brain 491.
Structure of the Spinal Cord 2437.
How Your Ears Carry Messages to Your Brain 1056.
How Our Ears "Hear" Air Waves 1057.
How We Move Our Eyes 1213.
Mechanism of the "Living Camera" in Our Heads 1214.
How the Eye "Shutter" is Controlled 1214.
Lens Action of the Eye 1988.
Focusing the "Living Camera" 1216.
The "Photographic Plate" of the Eye 1216.
The White-Capped Millers that Grind Our Food 3453.
How We Do Our Tasting 3513.
How the Heart Keeps the Blood Stream Flowing 1616.
Where We Get Air into the Blood 2083.
Muscles that Work the Arm 2372.
Muscles under the Microscope 2373.
How We "Work" Our Legs 2373.
A Heavy Load We Never Notice 50.
The Inside Facts about the Air We Breathe 52.
Measuring Air Moisture 1717.
The Most Wonderful of All Life's Processes 395.
Birth of a New Cell—Multiplying by Dividing 671.
How Single Cells Grow into Thousands 672.
How the Old Life Passes into the New 1643.
How Your Finger-Prints Follow You Through Life 1248.
Here's a Test for Quickness and Accuracy 1792.
Testing the Speed of Eye and Brain 1793.
Exercises to Keep You Strong and Healthy 2785.
Illustrating Some Rules of Hygiene 1714-5.
Why Everybody is Drowsy but Baby 1712.
Picture Aids to Baby Care 292-4.
The Right Kind of a Breakfast 1320.
This is Her Dinner 1321.
And This is Her Supper 1321.
Guardians of Our Health at Work 1613.
The Furnace that Tends Itself 1623.
Cleaning up the City of Colon 2655.
Filtering Water for a Great City 3703.
Picture Guides to First Aid Work 1267-70.
Sir James Y. Simpson Discovering the Power of Chloroform 124.
The Sleep that Saves from Pain 125.
Bacteria of Sour Milk, Alcohol, Vinegar, and Cheese 302.
Germs of Typhoid, Sleeping Sickness, and Plague 1450.
Diphtheria Bacilli, Cholera Germs, and "White Plague" Germs 1452.
The Flea that Carries Plague 1292.
A Deadly Enemy of Mankind 1312.
The Anopheles Mosquito, Carrier of Malaria 2334.
The "Biting" Apparatus of the Female Mosquito 2334.
The Yellow Fever Carrier 2336.
How Mosquitoes Spread Malaria 2337.
Various Kinds of Parasites 2678-80.
A Curious Way to Cure the Toothache 1750.
Propitiating the God of the Waters 1768.
Work of the Medicine Men among the Indians 1773.
Magic Rites to Cure Illness 2118.
The Witch Doctor's "Watch Dog" 2120.
How Our Invisible Defenders Resist Disease 1451.
Making Typhoid Vaccine for the Army 3613.
Poisons that Grow in Field and Forest 2852-5.
How the Mysterious X-Rays are Created 3825.
How a Doctor Sees Your Bones 3826.

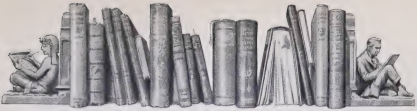
Books on Physiology and Hygiene

FOR YOUNG READERS

Our Bodies and How We Live. Albert Franklin Blaisdale.
The Child's Day. Woods Hutchinson.
The Body at Work. Francis G. Jewett.
Primer of Sanitation and Physiology. John Woodside Ritchie.
Health, Strength, and Power. Dudley Allen Sargent.
Health in Home and Town. Bertha M. Brown.
Wonders of Science. Eva March Tappan.
How to Get Strong. William Blaikie.
Sound Bodies for Our Boys and Girls. William Blaikie.
Primary Physiology and Hygiene. James W. Mayberry.
First Aid for Boys. Norman B. Cole and Clayton H. Ernst.

FOR OLDER READERS

Physiology and Health. Herbert W. Conn.
Studies in General Physiology. Jacques Loeb.
Practical Physiology. A. P. Beddard.
The Elements of Physiology and Sanitation. Louis John Rettger.
Healthful Living. Jesse F. Williams.
Health and Social Progress. Rudolph M. Binder.
Physiological Chemistry. Albert P. Mathews.
How to Keep Well. William A. Evans.
The Efficient Life. L. H. Gulick.
How to Live: Rules for Healthful Living. Irving Fisher and Eugene Lyman Fiske.
A Textbook of Gymnastics. K. A. Knudsen.
How to Breathe Right. Edward Lankow.
A Rational System of Home Exercise. P. G. Masters.
The Newer Knowledge of Nutrition. Elmer V. McCollum.
Vitamines, Essential Food Factors. Benjamin Harrow.
Food Values, What They are and How to Calculate Them. Margaret McKillop.
American Red Cross Textbook on Home Dietetics. Ada Z. Fish.
Social Service and the Art of Healing. R. C. Cabot.
Medical Science of Today. W. H. Evans.
A Text-Book of Gymnastics. K. A. Knudsen.
Nerves and the Man. W. Charles Loosmore.
The History of Medicine. D. A. Gorton.
History of Osteopathy and Twentieth Century Medical Practice. E. R. Booth.
Short History of Nursing. Lavinia L. Dock.
A Text-Book of Simple Nursing Procedure. Amy E. Pope.



LANGUAGE *and* LITERATURE

LANGUAGE is the tool of thought. To think clearly and to grasp firmly the expressed thoughts of others requires a sure knowledge of words and of the manner in which words are put together into phrases and sentences. But language is not an artificial product of science, governed by rigid rules and conventions which can be memorized. It is a gradual growth, rooted in custom and tradition, improved by centuries of development, and enriched by the skilful use of generations of great minds. The study of grammar alone will not, therefore, give us the mastery of language essential to clear thought and understanding. We must get a certain intuitive "feel" for our own tongue which can be obtained only by steeping ourselves in the great literature of the past and the present. If we can also familiarize ourselves with the famous masterpieces of other languages, we shall redouble our capacity for expression and enjoyment.

- I. THE THEORY OF LANGUAGE:
  - **A.** Philology, the Science of the Growth and Relationship of Languages: **2770.**
    - **a. Etymology, the History of Words: 2771.**
      - **1.** Etymology of English Words: 1161.
      - **2.** How Personal Names Originated: 2388.
      - **3.** How Slang Words Have Crept into Languages: 3248.
    - **b. Language Types: 2771.** Inflected, Agglutinative, and Isolating Languages.
  - **B.** Grammar, the Science of the Correct Use of Language: **1492.**
    - **a. Sentence: 3174, 1493.** Phrases and clauses; sentences classified according to structure.
    - **b. Parts of Speech: 1494.** Nouns 2537; Verbs 3627; Pronouns 2921; Adjectives 25; Adverbs 26; Conjunctions 862; Prepositions 2912; Interjections 1493.
    - **c. Punctuation: 2934.**
  - **C.** Rhetoric, the Art of Effective and Pleasing Use of Language: **3004; Figures of Speech: 1238.**
- II. THE LANGUAGES OF VARIOUS PEOPLES:
  - **A.** African Languages: **37.**
  - **B.** Asiatic Languages:
    - **a. Chinese: 744.**
    - **b. Indian: 1748.**
    - **c. Hebrew: 1624.**
  - **C.** European Languages: **1192.**
    - **a. Teutonic Tongues: 3472; 2771.** English 1161; German 1435; Scandinavian 3134.
    - **b. Celtic Languages: 674, 1814.** Erse, Manx, Gaelic, Welsh, and Breton.
    - **c. Romance Languages: 3040.** French 1363; Italian 1832; Spanish 3307; Portuguese 2889.
    - **d. Slavonic Languages: 3250.** Russian, Polish, Serbian, etc.
    - **e. Non-Aryan Tongues of Europe:** Magyar 1702; Finnish 1248; Esthonian 1180.
  - **D.** Languages of Indigenous American Peoples:
    - **a. Indian Languages and Dialects: 1768.**
    - **b. Eskimo Language (also in Asia): 1174.**
  - **E.** Artificial Universal Languages (Esperanto, Volapuk): **1177.**
  - **F.** Ancient Languages: **Greek 1534; Latin 1965; Sanskrit 2771.**
- III. WRITTEN LANGUAGE:
  - **A.** Writing: **3816.**
    - **a. Picture-Writing and Hieroglyphic Writing: 1649, 100.**
    - **b. Cuneiform Writing: 939, 294.**
    - **c. Alphabetic Writing: 100, 2774.**
    - **d. Methods and Materials:** Handwriting 1574; Shorthand 3224; Typewriter 3573; Pen 2709; Paper 2666; Ink 1779; Pencil 2712.
  - **B.** Printing: **2916.**
    - **a. Type and Typemaking: 3572.**
      - **1.** Linotype: 2019.
      - **2.** Monotype: 2303.
      - **3.** Electrotyping and Stereotyping: 1125, 3355.
    - **b. Products of the Press:** Books 455; Newspapers 2472; Magazines 2475.

- IV. FORMS OF LITERATURE:
  - A. Poetry and Its Forms: **2850.**
    - a. **Lyric: 2851.** For examples read Burns' 'Lines to a Daisy' 542; Joyce Kilmer's 'Trees' 173; A. E. Houseman's 'Shropshire Lad' 2850.
    - b. **Dramatic: 2851, 1031.** Shakespeare's plays furnish an excellent example of dramatic poetry.
    - c. **Epic: 2851.** Milton's 'Paradise Lost' (2244), and Spenser's 'Faerie Queene' are well known epics.
  - B. **Prose Forms:** Romance 3039; Novel 2539; Short Story 2541; Oration 3004, 1537; Essay 1177.
  - C. **Drama: 1032.**
- V. NATIONAL LITERATURES:
  - A. **Hebrew Literature: 1624.** Read the articles on the Old Testament (388) and on the Book of Job (1894) which is considered to be among the greatest poems dealing with man's spiritual history.
  - B. **Other Asiatic Literatures:**
    - a. **Arabian:** See 'Arabian Nights' (168) and 'Story of Aladdin's Lamp' (169).
    - b. **Chinese: 744.**
    - c. **Hindu: 1755.**
    - d. **Persian: 2738.**
  - C. **Greek and Latin Literature: 1534, 1965.**
    - a. **Great Greek Authors and Their Works:** Homer 1675 (stories from the 'Iliad' 3542, 8, 9, 248, 1626; stories from the 'Odyssey' 2562, 944); Aesop and his Fables 30; Herodotus 1645; Socrates 3270; Plato 2832; Aristotle 195; Xenophon 3823; Demosthenes 993; Plutarch 2840.
    - b. **Some Great Roman Authors:** Cicero 765; Caesar 563; Vergil 3630 (The Story of the Wooden Horse from the 'Aeneid' 3542).
    - c. **Drama and Dramatists: 1032, 1038.** Aeschylus, Sophocles, Euripides, Aristophanes, and Menander, famous Greek dramatic writers; Plautus, Terence, and Seneca, great dramatists of the Romans.
    - d. **Mythology:** See the Study Outline on Mythology.
  - D. **English Literature:** 1163, 3039.
    - a. **Early Literature:** 'Beowulf', the great Anglo-Saxon Epic; Arthurian Legends 223, 3068, 1391; Legends of Robin Hood 3028.
    - b. **Chief Poets and Their Works:** Caedmon 563; Geoffrey Chaucer 701 (Tales Told by the Canterbury Pilgrims 704); Sir Thomas More 2325; Sir Walter Raleigh 2974; William Shakespeare 3188 ('As You Like It' 224, 'Hamlet' 1569, 'King Lear' 1926, 'Macbeth' 2094, 'Merchant of Venice' 2199, 'Midsummer Night's Dream' 2230, 'Othello' 2603, 'Romeo and Juliet' 3058, 'The Tempest' 3465, 'Winter's Tale' 3756); John Milton 2240 (The story of 'Paradise Lost' 2244); John Dryden 1043; Alexander Pope 2879; Oliver Goldsmith 1483; William Cowper 910; Robert Burns 541; Sir Walter Scott 3150; Samuel Taylor Coleridge 825; William Wordsworth 3788; Lord Byron 551; Percy Bysshe Shelley 3204; John Keats 1914; Elizabeth Barrett Browning 516; Robert Browning 517; Alfred Tennyson 3470; Rudyard Kipling 1926.
    - c. **Chief Prose Writers and Their Works:** Sir Thomas Malory's 'Morte d'Arthur' 223; Lord Francis Bacon 300; John Bunyan 534 (story of 'Pilgrim's Progress' 535); Daniel Defoe 986 (story of 'Robinson Crusoe' 933); Jonathan Swift 3406 (story of 'Gulliver's Visit to Lilliput' 3407); Samuel Johnson 1898; Oliver Goldsmith 1483; Edmund Burke 540; Charles Lamb 1957; Sir Walter Scott 3150 ('The Tournament of Ashby' from 'Ivanhoe' 3152); Thomas Macaulay 2093; Thomas Carlyle 644; Benjamin Disraeli 1013; John Ruskin 3083; William Makepeace Thackeray 3479 (story of 'The Newcomes' 3480); Charles Dickens 1006 (story of 'Pickwick Papers' 1007, story of 'A Christmas Carol' 760); "George Eliot" 1134 (story of 'Silas Marner' 1135); "Lewis Carroll" 647 (story of 'Alice in Wonderland' 647); Thomas Hardy 1582; Robert Louis Stevenson 3355; Rudyard Kipling 1926 ('The Story of Mowgli' from 'The Jungle Book' 1927); Sir James Matthew Barrie 333 (story of 'Peter Pan').
    - d. **Drama and Chief Dramatists:** 1164, 1034, 2259. For a list of England's chief dramatists and their works see page 1038.
  - E. **Irish Literature: 1814.**
    - **—Drama and Dramatists: 1036, 1038.**
  - F. **American Literature: 111.**
    - a. **Chief Poets:** William Cullen Bryant 521; Edgar Allen Poe 2848; Ralph Waldo Emerson 1141; Henry David Thoreau 3492; Henry Wadsworth Longfellow 2057 (story of 'The Song of Hiawatha' 2059); Oliver Wendell Holmes 1674; John Greenleaf Whittier 3736; James Russell Lowell 2073; Walt Whitman 3734; Eugene Field 1236; James Whitcomb Riley 3020.
    - b. **Chief Prose Writers:** Benjamin Franklin 1357; Washington Irving 1830; James Fenimore Cooper 878; Edgar Allen Poe 2848; Nathaniel Hawthorne 1607; Oliver Wendell Holmes 1674; Harriet Beecher Stowe 3368; Henry David Thoreau 3492; Edward Everett Hale 1561 (story of 'The Man Without a Country' 1562); Francis Parkman 2686; Bret Harte 1594; Louisa May Alcott 84; "Mark Twain" 3569; William Dean Howells 1689; Sydney Lanier 1961; William Sydney Porter ("O. Henry") 2884; John Burroughs 543; John Muir 2365.
    - c. **Drama and Dramatists: 1036, 1038.**
  - G. **Canadian Literature: 623.** William Henry Drummond and his works 1042; Sir Gilbert Parker and his works 2685; a folklore tale of the Canadian Indians from Cyrus Macmillan's 'Fairy Tales from Canada' 611.

- **H. French Literature: 1363.**
  - **a. Early Romance: 3039.** Story of Roland 3038.
  - **b. Chief Poets and Prose Writers:** Jean Froissart 1375; François Rabelais 2951; Michel de Montaigne 2308; Pierre Corneille 891; Madame de Sévigné 3181; Jean Baptiste Racine 2957; Molière 2279; Voltaire 3660; Jean-Jacques Rousseau 3070; Honoré de Balzac 323; Victor Hugo 1694 (story of Jean Valjean from 'Les Miserables'); Alexandre Dumas 1047; Jean-Henri Fabre 1217; Emile Zola 3840.
  - **c. Drama and Chief Dramatists: 1034, 1036.** For a list of the chief dramatists of France and their works see page 1038.
  - **d. French Academy: 4.**
- **I. German Literature: 1435.**
  - **a. Early Literature: 1436.** Song of the Nibelungs 2504.
  - **b. Some Important Figures in German Literature and Their Works:** Martin Luther 2084; Johann Wolfgang Goethe 1477; Johann Christoph Friedrich Schiller 3137; Heinrich Heine 1628; Richard Wagner 3663.
  - **c. Chief Dramatists: 1038.**
- **J. Russian Literature: 3096.**
  - **a. Chief Authors and Their Works: 3098.** Ivan Turgenief 3554; Leo Tolstoy 3512.
  - **b. Chief Dramatists and Their Works: 1038.**
- **K. Italian Literature: 1832, 2995.**
  - **a. Chief Authors and Their Works: 1833.** Dante Alighieri 957 (story of Dante's 'Divine Comedy' 958); Torquato Tasso 3439; Francesco Petrarch 2995; Giovanni Boccaccio 2996.
  - **b. Chief Dramatists: 1038.**
- **L. Spanish Literature: 3307.** Miguel de Cervantes Saavedra 682 (story of 'Don Quixote' (683); Vicente Blasco Ibanez 1719.
  - **b. Chief Dramatists and Their Works: 1038.**
- **M. Scandinavian Literatures: 3134, 1724.**
  - **a. Early Literature:** see the Outline on Mythology under the heading Norse and Teutonic Mythology.
  - **b. Some Scandinavian Writers:** Selma Lägerlof 1957; Björnstjerne Björnson 432; Henrik Ibsen 1721; Hans Christian Andersen 121.
- **N. Other European Literatures:**
  - **a. Portuguese: 2889.**
  - **b. Belgian:** Maurice Maeterlinck 2111; story of 'The Blue Bird' 2113.
  - **c. Dutch:** Erasmus of Rotterdam 2996.

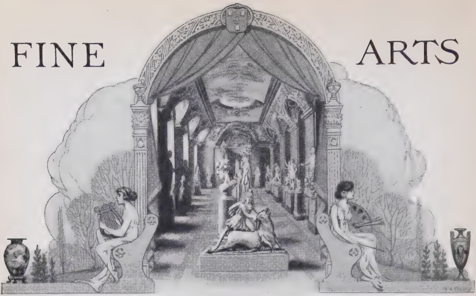
VI. READING: 2979.

- **A. Literature for Children: 2027.**
- **B. Libraries and How to Use Them: 1991.**

Books for the Literature Student

Development of English Literature and Language. Alfred H. Welsh.
The English Language. Logan Pearsall Smith.
The History of the English Language. O. F. Emerson.
The Making of English. Henry Bradley.
History of the English Language. Thomas R. Lounsbury.
The Standard of Usage in English. Thomas R. Lounsbury.
Words and Their Ways in English Speech. J. B. Greenough and G. L. Kittredge.
The Study of Words. R. C. Trench.
A Primer of English Etymology. W. W. Skeat.
The Romance of Words. Ernest Weekley.
Eighteen Thousand Words Often Mispronounced. W. H. P. Phyfe.
English Composition and Style. W. T. Brewster.
The Author's Craft. Arnold Bennett.
Introduction to the Methods and Materials of Literary Criticism. C. M. Gayley and F. N. Scott.
Gateways to Literature. Brander Matthews.
Literary Taste, How to Form It. Arnold Bennett.
The Choice of Books. Frederic Harrison.
Appreciation of Literature. George Edward Woodberry.
Talks on the Study of Literature. Arlo Bates.
Essays in Criticism. Matthew Arnold.
Literary Essays. James Russell Lowell.
Lectures on the English Poets. William Hazlitt.
Studies in Literature. Edward Dowden.
Familiar Studies in Men and Books. Robert Louis Stevenson.
Sesame and Lilies. John Ruskin.
Initiation into Literature. Émile Faguet.
Voices of Tomorrow. E. Björkman.
History of English Literature. H. A. Taine.
English Literature. Stopford Brooke.
Illustrated History of English Literature. Richard Garnett and Edmund L. Gosse.
English Literature. William J. Long.
American Literature. William J. Long.
The Spirit of American Literature. John Macy.
History of Classical Greek Literature. J. P. Mahaffy.
History of Ancient Greek Literature. G. G. Murray.
Latin Literature. J. W. Mackaie.
Short History of French Literature. George Saintsbury.
History of German Literature. W. Scherer.
History of Italian Literature. Richard Garnett.
History of Spanish Literature. George Ticknor.
An Outline of Russian Literature. M. Baring.
World Literature and Its Place in General Culture. Richard Green Moulton.
The Nature and Elements of Poetry. Edmund Clarence Stedman.
Handbook of Poetics. Francis B. Gummere.
The English Novel. Sir Walter Raleigh.
Development of the English Novel. Wilbur L. Cross.
The Advance of the English Novel. William Lyon Phelps.
A Study of Prose Fiction. Bliss Perry.
Philosophy of the Short Story. Brander Matthews.
English Drama. F. E. Schelling.
A Book About the Theatre. Brander Matthews.
Modern Dramatists. Ashley Dukes.
The British and American Drama of Today. Barrett H. Clark.
Main Currents of the Nineteenth Century. Georg Brandes.

FINE ARTS



ART is as old as the human race. Long before men learned to write, they were striving to express in concrete form their faith and their fears, their ideals and their hopes. Crude monuments to the dead, figures carved in bone, horn, and ivory, drawings upon cave walls are among the most valuable records we possess of the civilization which existed before the dawn of history. Ancient traditions and legends were embodied in songs which were passed on from generation to generation before alphabets were invented. And, as civilization grew, men placed more and more emphasis upon the expression of their emotions and their sense of beauty through the arts. Artists were honored above all other workers, and took their station by the side of kings and nobles. Today we build veritable palaces in which to house great paintings and statues; we exalt those who can play or sing with special skill the masterpieces of music; we travel half-way around the world to view the outlines of some famous building. But aside from the pleasure it gives us, a study of Art has an educational importance often overlooked. The history of Art is also the history of the manners and customs of people in all periods and countries. It contains a vivid narrative of the development of ideas and ideals, and gives us a key to the story of mankind often more valuable than any written record. The Fine Arts may be grouped in various ways according to different points of view. Primarily, however, they are usually grouped into Major and Minor Fine Arts.

I. **THE MAJOR FINE ARTS:** Architecture, Sculpture, Painting, Music, and Poetry. In the following Study Outlines is gathered together the material on the first four of these subjects. The material on Poetry will be found in the preceding Outline on Language and Literature.

II. **THE MINOR FINE ARTS:** Among the many Minor Fine Arts may be mentioned Drama 1031, 3482; Dancing; Engraving and Etching 1168; Mosaic Working 2330; Tapestry Weaving 3433; Embroidery 1140; Stained Glass Making 1474; Ceramics 2903, 1874; The Glyptic Arts of Modeling and Carving Medals, Intaglios, Cameos, Jewelry, etc. 591; Joinery 1383. Most of the Minor Fine Arts, it will be seen, are closely allied with a Major Art, as Mosaic Working with Painting and the Glyptic Arts with Sculpture.

Architecture

I. **EGYPTIAN ARCHITECTURE: 176, 1099.**
   - A. **Characteristics:** Vast tombs of kings and solemn temples of the gods, built by an enslaved population; massive stone edifices of the "column and lintel" type, with walls often sloping instead of perpendicular on the outside; use of column foreshadowing Greek architecture; profuse ornamentation, both carved and painted.
   - B. **Some Notable Examples:** Pyramids 2939, 178 (picture); Temple of Karnak 176 and 178 (pictures); columns 1105 (picture); pylon 1104 (picture), Avenue of Sphinxes 1101 and 1103 (pictures); Obelisks 1105; Temple of Isis at Philae 1107, 1106 (picture).

II. **BABYLONIAN AND ASSYRIAN ARCHITECTURE: 176.**
   - A. **Characteristics:** Gorgeous temples and palaces set on broad terraces, approached by imposing stairways

and built of baked or sun-dried brick and enameled tile; stone used in later period; arch and turret forms often employed.

- **B. Typical Examples:** Hanging Gardens of Babylon 3177, 3179 (picture); palace of an Assyrian King 295 (picture).

III. GREEK ARCHITECTURE: 176.

- **A. Characteristics:** Noble temples, theaters, gymnasia, etc.; "column and lintel" type of edifice, built of marble or of coarser stone covered with stucco, sometimes without a roof, sometimes roofed with tiles or slabs supported on wooden beams; three styles or "orders"—Doric, Ionic, and Corinthian 177, 180, (picture).
- **B. Some Notable Examples:**
  - **a. Doric:** Parthenon 11, 176 (picture); temple of Theseus 250 (picture).
  - **b. Ionic:** Temple of the Wingless Victory 250 (picture); Mausoleum at Halicarnassus 1531 (picture); Erechtheum 11, 250 (picture).
  - **c. Corinthian:** Monument of Lysicrates 250 (picture).

IV. ROMAN ARCHITECTURE: 177.

- **A. Characteristics:** Stately, ostentatious temples, monuments, basilicas, forums, amphitheaters, and circuses, and highly practical aqueducts and baths; richly ornamented buildings built of brick, stone, and cement and concrete and faced with brick, marble, or mosaic; structural forms included. The arch (174), the vault, the dome, and columns of the three Greek orders.
- **B. Some Notable Examples:** Pantheon 181 (picture); Colosseum 3050, 181 (picture); Forum 3050, 3053 (picture); Baths of Caracalla 3052, 3057 (picture); Castle of Sant' Angelo or Mausoleum of Hadrian 3051 (picture); Arch of Titus 3051 (picture); aqueduct at Segovia 163 (picture); residence at Pompeii 2877.

V. BYZANTINE ARCHITECTURE: 178.

- **A. Characteristics:** Huge squatty churches, with interiors of soaring splendor and dazzling magnificence; domes placed over rectangular compartments by means of pendentives; buildings constructed of brick and stone faced with precious marbles and gorgeous mosaics 552, 2630 (picture).
- **B. Some Notable Examples:** Santa Sophia at Constantinople 182 and 183 (pictures); St. Mark's Cathedral at Venice 3623, 1197 (picture); Church of the Three Saints at Jassy 3082 (picture).

VI. MOHAMMEDAN ARCHITECTURE: Called "Moorish" or "Saracenic" in the West.

- **A. Characteristics:** Graceful gay-hued mosques and tombs with bulbous domes, round, lancet, and horseshoe arches, slender minarets, and fretted screens in geometric patterns or arabesques; built of all structural materials including marble, and decorated with exquisite mosaics and inlays of silver, gold, enamels, and semi-precious stones.
- **B. Typical Examples:** Taj Mahal 3429, 3431 (picture); Tomb at Agra 1754 (picture); palaces in India 1755 (picture); tower at Delhi 989 (picture); Mosque of Shah Jehan 990 (picture); Azhar Mosque at Cairo 569 (picture); Mosque at Constantinople 2276 (picture); one of Teheran's Porcelain Gates 2736 (picture); Alhambra 3298 (picture).

VII. ROMANESQUE ARCHITECTURE: 180. Called "Lombard" and "Tuscan" in Italy, "Romane" in France, "Rhenish" in Germany, and "Saxon" and "Norman" in England and Scotland.

- **A. Characteristics:** Dignified churches and palaces and massive castles; round arches framing doors and windows and springing from round columns or piers to form the cloisters or arcaded courts of churches; thick stone walls pierced with small windows; roofs at first flat and timbered, later vaulted in stone by means of the plain barrel or groined vault; decoration sometimes rude and spare, sometimes rich and exuberant.
- **B. Some Notable Examples:** Cathedral of Pisa 2811 and 184 (pictures); Leaning Tower of Pisa 2810, 2811 (picture); Tower of London 2049, 2056 (picture); Carnavon Castle, Wales 3665 (picture).

VIII. GOTHIC ARCHITECTURE: 181, 662. Divided into periods in different countries, "Lancet," "Rayonnant," and "Flamboyant" in France; and "Early English," "Decorated," and "Perpendicular" in England. "Tudor" is late Perpendicular already verging toward the Renaissance style.

- **A. Characteristics:** Wonderfully varied forms especially in cathedrals; emphasizing the vertical line, and reaching to new heights, with great lofty window spaces filmed with stained glass; use of pointed arch 187 (picture); timbered roofs used in residences and smaller churches and vaulted stone roof supported on stone ribs in larger edifices; stone walls thinner than in Romanesque buildings and reënforced by close and flying buttresses 186 and 1199 (pictures); decoration sometimes severe and sparse, sometimes rich and fantastic.
- **B. Some Notable Examples:** Cathedral of Notre Dame 185 and 186 (pictures); Cathedral of Amiens 117 (picture); Giotto's Tower, Florence 1461, 1462 (picture); Cathedral of Florence 1834 (picture); Cathedral of Milan 1843 and 1199 (pictures); Cologne Cathedral 834 (picture); Cloth Hall at Ypres 3834 (picture); Westminster Abbey 2049 and 3719 (pictures); Canterbury Cathedral 637 (picture).

IX. RENAISSANCE ARCHITECTURE: 188, 2997.

- **A. Characteristics:** Sumptuous palaces, chateaux, and churches, expressing not the spirit of whole peoples but the moods and whims of luxurious intellectual aristocracies; formal and classical by intention, and in detail consisting largely of borrowings from Roman antiquity; degenerating finally into the frenzy of the Baroque and Rococo; no new structural features.
- **B. Some Notable Examples:** St. Peter's Church 3052, 187 (picture); Palazzo Vecchio at Florence 1849 (picture); St. Paul's Cathedral at London 2052, 2048 (picture); Louvre 1203 (picture); Chateau of Chenonceaux 1342 (picture).

X. MODERN ARCHITECTURE: **189.**

A. **Characteristics:** After the Renaissance the broad national movements in Architecture virtually ceased and the new designs were the products of individual architects who originated a wide variety of schools more or less independent of one another. All the styles of the past were largely drawn upon, their adaptation to modern use sometimes resulting in well-established new styles such as Mission and Colonial. It was only with the advent of steel and concrete that great new structural principles were evolved. Read the article on Building Construction (528).

B. **Examples of Modern Styles:**
- a. **Mission:** A Franciscan mission in California 2301 (picture); Leland Stanford Junior University 581 (picture).
- b. **Colonial:** Washington's home at Mount Vernon 2358 (picture); White House 3734 (picture); house of William Penn 2761 (picture).
- c. **"American Renaissance" or Classic Revival:** United States Capitol at Washington 3681 (picture); Pennsylvania Station in New York City 2496 (picture).
- d. **Modern Gothic:** Houses of Parliament at London 2049 and 2687 (pictures).
- e. **Sky-scrapers:** A Chicago sky-scraper 188 (picture); the Woolworth Building 2489 (picture); a sky-scraper in process of construction 529 (picture).

XI. ANCIENT NON-CLASSICAL ARCHITECTURE: This includes isolated types of architecture which have played no part in the great chain of development dealt with above.

A. **Chinese Architecture:**
- a. **Characteristics:** Gay, bright, comparatively fragile pagodas and memorial gateways built of wood, brick, glazed tile, and, less often, of stone; dominant feature is the tent-like curved roof.
- b. **Examples:** Temple of Heaven 2708 (picture); arched gateway 747 (picture); tower and gate 2707 (picture).

B. **Hindu Architecture (Including Javanese) before the Mohammedan Conquest: 1755.**
- a. **Characteristics:** Strange tombs, shrines, and temples, often scooped from the living rock of caves and hills, or built of stone with high pyramidal towers, fantastically ornamented.
- b. **Examples:** Pagoda 1753 (picture); Buddhist temple 1878 (picture).

C. **American Indian Architecture:**
- a. **Inca Architecture: 1741.** Structures composed of stones, often huge bowlders, put together without mortar, but cut and fitted with extreme accuracy.
- b. **Aztec Architecture: 289 (picture).** Houses of sun-dried brick and great pueblos, usually of stone, temples and palaces of brick or stone elaborately decorated with carvings and gilding.
- c. **North American Indian Architecture:** Log dwellings of most advanced hunting tribes 1774 (picture); stone dwellings of the Cliff Dwellers 794, 793 (picture); sun-dried brick dwellings of the Pueblo Indians 1767, 1766 (picture); homes of the Walpi Indians 2463 (picture).

Sculpture

I. SCULPTURAL METHODS: **3154.**

A. **Incised Design: 668 (picture).** This method of drawing with a sharp point, practised by cavemen in prehistoric times, though not what we would today call sculpture, may very well have been its direct ancestor.

B. **Sculpture in Relief: 3154.**
- a. **Bas-Relief or Low Relief: 296 and 3157 (pictures).** In these sculptures the artists have cut back their background to the depth of the shallow figures and have used modeling freely.
- b. **High Relief: 3156 (picture).** Here the composition as a whole is part of the slab, but limbs and heads of individual figures here and there are almost free.
- c. **Sunk Relief or Cavo-Rilievo: 1104 (picture).** In this method the artist cuts into a flat surface so as to leave the figures standing in relief on a sunken ground.

C. **Intaglio: 3154.** In this method—the opposite of relief—the design is hollowed out below the surface. It is used mainly in the carving of precious stones and in making seals, etc.

D. **Sculpture "in the Round": 3154.** This is the most "complete" form of Sculpture, the figures being in part, at least, completely "free," so they may be viewed from all sides.

II. PRIMITIVE SCULPTURE: **3155.** The beginnings of sculpture arise wherever men have the impulse to adorn articles of use with decorative shapes, like those of the carved pipes and bowls (1766, 1767) made by Indian craftsmen, or to give outward form to their imaginings concerning the gods or spirits they worship, as did the Alaskan tribesmen who carved totem-poles (74), or to erect memorials bearing the features of the dead, as possibly did the mysterious unknown race that carved the "stone men" of Easter Island (2619).

III. EARLY DEVELOPMENT:

A. **Egyptian Sculpture:**
- a. **Characteristics and Materials: 3155.**
- b. **Typical Examples:** The Sphinx 3316, 1103, 3155; the head of Ptolemy Auletes, which shows that portraiture was comparatively highly developed, 1206; statues of an Egyptian official and his wife, 1206; of Amenhotep III, 1105; of Rameses II, 1106; figures on the pylon, 1104.

B. **Babylonian and Assyrian Sculpture:**
- a. **Characteristics: 3155.**

- **b. Typical Examples:** Assyrian animal sculpture, 296; winged bulls, which are as typical of Assyrian sculpture as the Sphinx is of Egyptian, 3155, 1206; winged god, 1206.
- **C. Aegean Sculpture: 3156, 29, 28 (picture).**

IV. GREEK AND ROMAN SCULPTURE:

- **A. Archaic Greek: 3156, 1529, 1530 (picture).**
- **B. The Great Age of Greek Sculpture: 1529.**
  - **a. The Work of Myron and Polyclitus, and of Phidias, Greatest of Greek Sculptors: 1530, 2759.**
  - **b. The Work of Praxiteles, Scopas, and Lysippus: 1530.**
  - **c. Typical Examples:**
    1. First Period: 'Discus Thrower' of Myron 1204; Polyclitus' statue of Hera 1639 (description); Phidias' statues of Zeus 3179, 3178 (description); of Athena 12 (description); fragments of the Parthenon frieze 1532, 248; the 'Three Fates' from the Parthenon pediment 1525; Venus de Milo 1203, 155.
    2. Second Period: The 'Hermes' of Praxiteles 3156; the Villa Ludovisi 'Mars' believed to be a copy of an original by Scopas or Lysippus 1530; the 'Artemis of Gabii' 1203.
- **C. Later Greek and Roman Sculpture: 1532.** Despite a gradual loss of directness and simplicity and an increasing tendency toward realism, affectation, and florid ostentation, many beautiful works were produced in the centuries following the 4th century B.C., and the Romans created fine portrait statues before art was extinguished in the West about the 4th century A.D.
  - **a. Late Greek Sculpture: 1532.**
  - **b. Roman Sculpture and How It was Influenced by that of the Greeks: 1533.**
  - **c. Examples:** The Apollo Belvedere 3159, 156; the Diana with the Stag 1205; the Flora 1204; the Wrestlers 1205; the Young Augustus 1532; Hadrian, Cicero, Hannibal, Trajan, Julius Caesar, Augustus, and Scipio Africanus 3043; reliefs of Trajan's Column 1533; Roman sarcophagus 3156.

V. MEDIEVAL AND RENAISSANCE SCULPTURE:

- **A. Medieval: 3156.**
  - **a. Early Gothic:** Sculpture in the early Christian centuries, hampered not only by lack of skilled artists but by literal interpretation of the commandment against making "any graven image," was confined chiefly to sarcophagi, crucifixes, and objects for the adornment and use of the church. With the rise of Romanesque and Gothic cathedrals and churches, sculpture was more and more freely used as an adjunct to architecture. The early Gothic artists worked "for the glory of God" and not for fame, and their names are lost to us.
  - **b. Late Gothic in Italy:** Many of the Italian sculptors of the late Gothic period were painters and architects as well. Such were Niccolo Pisano, whose works (Pisan pulpit 1205) show study of the antique and thus foreshadow the Renaissance; Giovanni, son of Niccolo (1201); Andrea Pisano, pupil of Giovanni; Arnolfo di Cambia; and Giotto (1461) who stood at the dawn of the Renaissance.
- **B. Renaissance: 3156, 2996.**
  - **a. Italian Renaissance:** Among the great sculptors of the early Renaissance were Ghiberti 1456; Donatello 3158; the Della Robbias 3158; Verrocchio 1853; Leonardo da Vinci 3644; Michelangelo 2220; Benvenuto Cellini 3158; Giovanni da Bologna 3158. Typical Examples: Ghiberti's bronze doors 1457; 'St. Cecilia' by an unknown sculptor 3157; 'Singing Galleries' of Lucca della Robbia 3160; statue of Captain Colleoni by Verrocchio 1204; Michelangelo's 'Giuliano de' Medici' 3159, 'Lorenzo de' Medici' 2191, 'The Descent from the Cross' 2220, and 'Moses' 2222; Bologna's 'Flying Mercury' 3159.
  - **b. French Renaissance:** The Renaissance dawned late in France. Jean Goujon and Germain Pilon were its most important sculptors, and their work, though graceful and often vigorous, is not free from the florid affectation of a declining age.

VI. "BAROQUE," LATE CLASSICAL REVIVAL, AND MODERN SCULPTURE: 3158.

- **A. "Baroque":** In Post-Renaissance sculpture (17th century), statuesque dignity gave way to violent fluttering movement and florid excesses. The chief sculptor and architect of this period was the Italian J. L. Bernini, a man of great talent and prodigious versatility, acclaimed in his day as a miraculous genius, who filled Rome with "an almost incredible quantity of sculpture of the most varying degrees of merit and hideousness." From Italy this movement spread all over Europe.
- **B. Classicist Revival: 3158.** A period of cold formal classicism followed the extravagances of the "Baroque" style. The leading figures in this movement were Canova, an Italian sculptor, and Thorwaldsen, a Dane. See Canova's figure of 'Perseus' 3159.
- **C. Modern Sculpture: 3158.**
  - **a. French Sculptors and Their Work: 3158.**
    1. François Auguste Rodin, the greatest sculptor since Michelangelo: 3036.
    2. Typical Examples of modern French sculpture: Houdon's 'Washington' 3161; Barye's 'Theseus Slaying the Centaur' 3160; Rude's 'Neapolitan Fisherboy' 3162; Chapu's 'Joan of Arc' 3162; Rodin's best known works 3037; Rodin's 'J. P. Laurens' 3162.
  - **b. Constantin Meunier of Belgium and His Work: 3158, 3161.**
  - **c. Modern Sculpture in England:**
    1. Thornycroft's 'Teucer': 3161.
    2. The extreme modern movement. 3164.

d. **American Sculpture: 3164.**

1. Saint-Gaudens and his work: 3107.
2. Some Typical Examples: Saint-Gaudens' 'Lincoln' 3161; Taft's 'Fountain of Time' 723, 'The Blind' 3163; Gutzon Borglum's 'North America' and Konti's 'South America' 109; French's 'Death and the Sculptor' 3163; Nellie Verne Walker's 'Her Son' (frontispiece, Vol. 8).

VII. ORIENTAL SCULPTURE:

A. **Indian Sculpture: 1755, 1749.** A style tending toward the monstrous and exuberant.

B. **Chinese and Japanese Sculpture: 1874, 744.**

a. **Japanese Sculpture:** The Japanese, refined and delicate artists though they are, seem to care little for the beauty of human figure. Yet the "Nara school" of sculpture (6th to 12th century A.D.) takes rank with the Florentine school of European sculpture. Examples 1749, 1873.

b. **Chinese Sculpture:** The Chinese have practiced sculpture in stone from early times without gaining any distinction in this direction. With the rise of Buddhism a school of sculptors sprang up, but their art showed no originality and was dominated by Indian models 638 (picture). The real beauty of Chinese sculpture lies in the exquisite bronzes and ivory carvings of the Golden Age, which have cast their influence over the art of many lands.

Painting

I. PRIMITIVE PAINTING: 2627.

A. **Stone Age: 666, 668.** Spirited animal paintings done in three colors on the walls of caves, and pictures scratched on bits of ivory and stone give evidence of the adroitness of hand and keenness of observation of the men of the Old Stone Age. Examples: 668, 2628.

B. **American Indian:** Far inferior to the work of the Stone Age are the grotesque childish drawings of the Aztecs and of the North American Indians. Examples: 290, 1769.

II. EARLY DEVELOPMENT OF PAINTING:

A. **Egyptian: 2627, 1100.** Paintings intended not only to decorate walls, but to furnish historical records; conventionalized and symbolic figures often done in brilliant colors which were decorative but not realistic. Examples: 1102, 2629.

B. **Babylonian and Assyrian: 2628.** Human figures less conventionalized, but also less spirited, and animals more truly portrayed than those of the Egyptians.

C. **Aegean Painting: 2628, 29.** Aegean art showed extraordinary power and vigor, less knowledge and accuracy than that of the Egyptian, but greater artistry; animals and plants were delightfully rendered.

D. **Greek and Roman Painting: 2628, 1529.**

a. **Greek:** An art which we can judge only from the descriptions of ancient writers who tell of the fine work of Polygnotus, the reputed founder of Greek painting, of Zeuxis, Parrhasius, Apelles, and others.

b. **Roman:** The great masterpieces of Roman painting, too, are lost to us, and only mural paintings preserved at Pompeii and elsewhere remain. They show that the art of the Augustan Age gave local color, natural flesh tints, and rounded modeling to figures. Although the Greek art was their model, it is believed that the Romans developed more originality in painting than in sculpture.

III. POST-ROMAN AND PRE-RENAISSANCE PAINTING:

A. **Early Christian: 2628.** Crude religious decorations painted by persecuted Christians on the walls of the catacombs and later on walls of churches; an attempt to adapt ancient art to religious subjects.

B. **Byzantine: 2628, 552.** Stiff and inexpressive but richly colored paintings and illuminated religious books overlaid with gorgeous conventional ornament and gleaming mosaics. Examples: 2630.

C. **Medieval and Gothic: 2628.** A period when the painter, as a rule, was an artisan employing his highest skill in following the instructions of the clergy who ordered religious paintings and dictated costume, pose, and composition.

IV. ITALIAN PAINTING AND THE RISE OF THE SCHOOLS: 2628, 2996, 2108.

A. **Florentine School:** These artists were the first to paint from Nature; they acquired also the mastery of Perspective (2740) and developed technique in Oil Painting.

a. **Early Renaissance (14th Century):** Cimabue, a half legendary figure, and his great pupil Giotto, who is looked upon as the head of the Florentine School, stand at the dawn of this period 1461, 2628; among the greatest of the "Giottesques" was Andrea di Cione, who called himself Orcagna.

b. **Later Renaissance (15th and 16th centuries): 2629.** Fra Angelico; Masaccio; Botticelli; Fra Filippo Lippi 2108; Uccello, Verrocchio, Ghirlandajo, Fra Bartolommeo, and Andrea del Sarto 2629-30. These are some of the great Florentine names before the school reaches its climax in the High Renaissance with the work of Leonardo da Vinci 3643 and Michelangelo 2220.

c. **Typical Examples of the Florentine School:** A fresco of Giotto's 2631; Leonardo da Vinci's 'Mona Lisa' 1203.

B. **Venetian School: 2629, 2630.** Not the exquisite Florentine line, nor the intellectual mysticism of Florence, but sumptuous vibrant color that reflected the gay and brilliant life of the Venetians marked the painting of this school.

a. **Great Artists:** Carpaccio, Gentile, Giovanni Bellini, Giorgione, Titian 3504, Paul Veronese, and Tintoretto.

b. Typical Examples: Titian's 'The Assumption of the Madonna' 3505, portrait of Philip II 2763; Veronese's 'Family of Darius at the Feet of Alexander the Great' 2641.

C. Sienese School: While this school perhaps surpassed the Florentine in poetry and tenderness, works of the first rank were rare, for it produced too quickly and too abundantly. Early in the 15th century it had begun to decline.

D. Umbrian School: 2629. The heir of the Sienese School produced an art full of freshness and poetry but somewhat limited and childish. Its two great masters were Perugino and Pinturicchio.

E. Raphael and the Roman School: 2976. The work of Perugino's great pupil, Raphael, was divided into three periods, the Umbrian, the Florentine, and the Roman. At Rome he became the head of a large school and held a veritable court. His successor Giulio Romano or "Jules Romain" was an able and prolific imitator whose work marks the beginning of Italian Decadence. Typical Examples: Raphael's 'Madonna of the Chair' 2109, 'Sistine Madonna' 2635; Romain's 'Dance of Apollo and the Muses' 156.

F. Other Italian Schools and Masters: In the late 15th century Padua produced a mighty genius Mantegna, whose work had a marked influence on Venetian art 2629; the glory of Parma was Correggio 2630; and many other towns produced lesser masters. The Bolognese or Eclectic School was one of incipient decadence (Example of its art: Guido Reni's 'Aurora' 259). Contemporary with it was the Naturalist School led by the fierce Caravaggio, painter of violent episodes of real life, and the romantic Neapolitan landscape painter, Salvator Rosa.

V. THE NORTHERN SCHOOLS: 2630. The Northern painters pursued no visions of ideal beauty; they painted the world they saw about them in realistic style.

A. Flanders: 2630. Minute careful exactness, rich color, and homely dignity characterized the best Flemish painting.

a. Great Artists: The Van Eycks; Memling who led the school at Bruges; Quentin Matsys; Rubens, the Titian of the North 3076; Rubens' great pupil Van Dyck 3618; Teniers; Van der Weyden; and others of lesser rank.

b. Typical Examples: 'William of Orange and Mary' by Van Dyck 2636; Van Dyck's Portrait of Himself 3618; 'Dedication of Decius Mus' by Rubens 2640.

B. Germany: 2630. German art at its best shadowed forth mystic imaginative aspirations through the medium of a harsh, uncompromising realism.

a. Noted Painters: Two great artists of the 16th century stand out above all others in the history of German painting—Albrecht Dürer 1048, and Hans Holbein 1672.

b. Typical Example of German Art: Holbein's 'Erasmus' 2636.

C. Holland: 2631. In the early 16th century a very individual school of Dutch painting arose, led by Lucas van Leyden whose work heralds the development of familiar art in Holland. In the 17th century Holland not only gave to the world one of the heroes of art, Rembrandt, but discovered a new world of subjects for painting, scenes of everyday life or "genre."

a. Noted Painters: Rembrandt, who began a new era by subordinating line and color to the subtle fleeting elements of light and shade 2994; Gerard Douw (Dou or Dow), Ferdinand Bol, and Jan Ver Meer, important members of Rembrandt's school; Frans Hals, who ranked not far below Rembrandt as a portrait painter 1566; Jan Steen, Adrian and Isaac Ostade, genre painters, as were most of Rembrandt's school; Meindert Hobbema and Jacob Ruysdael, landscape painters; Paul Potter, noted as an animal painter; and Albert Cuyp, who excelled in both landscape and animal paintings.

b. Typical Examples: 'Portrait of an Old Lady' by Rembrandt 2639; Rembrandt's Portrait of Himself 2994; 'The Assembly of the Arquebusiers' by Frans Hals 2640; 'Avenue of Middleharnis' by Hobbema 2637.

VI. SPANISH, FRENCH, AND BRITISH PAINTING DOWN TO 1800:

A. Spain: The natural tendency of early Spanish artists was toward an ascetic style. They painted emaciated Virgins and Christs. The influence of the Italian Renaissance did much toward establishing a more natural art, and finally in the work of Velasquez, Spanish painting was released from the grip of Spanish mysticism.

a. Noted Painters: José di Ribera, called by the Italians Lo Spagnoletto—the Little Spaniard—who deserted his native country to become the disciple of Caravaggio in the Neapolitan Naturalist School; Velasquez 3619; Murillo, another of the world's great masters 2370; the bold and versatile Goya, the last great Spanish painter until Fortuna in the middle of the 19th century.

b. Examples of Spanish Painting at Its Best: Portrait of Don Balthasar Carlos by Velasquez 2636; 'Immaculate Conception' of Murillo 2371.

B. France: For three centuries painting in France was largely a court luxury, and for the first two of those centuries mainly an importation from Flanders and Italy. The classical landscape was a French development (2631). Vast grandiose classical compositions were produced in the reign of Louis XIV. Then the keynote changed to frivolous gayety and elegance. By contrast the "back-to-nature" philosophy of Rousseau expressed in paint in the work of Greuze and Chardin pleased the fastidious taste of an artificial age.

— **Noted Painters:** Nicolas Poussin, first notable French painter 1202; Charles Le Brun, court painter to Louis XIV; Claude Lorrain, the "discoverer of sunlight," who developed the classical landscape 2631; Antoine Watteau, one of the world's great masters, in whose work French elegance and vivacious charm find their first expression; Nattier, painter of the great ladies of Louis XV's court; Boucher and Fragonard, in whose work beauty tends toward mere prettiness; sentimental Greuze and unaffected modest Chardin, painters of humble bourgeois subjects; Mme. Vigée-Lebrun 1203 (picture).

- **C. Great Britain: 2631.** British art was chiefly influenced by Flemish and German styles. Not until the 18th century did any great British painters appear.
  - **a. Chief 18th Century Painters:** Hogarth "most forcible and exact exponent of his own rough land and time" 2631; the courtly group of great portrait painters, Reynolds, Gainsborough, and Romney, with Raeburn, Hoppner, Lawrence, and others of less importance, who form a bridge to the 19th century; Morland, first of English genre painters; and visionary William Blake.
  - **b. Examples of Their Work:** Gainsborough's portrait of Mrs. Siddons 2636; 'Serena' by Romney 2981.

VII. MODERN PAINTING: 2631. In the 19th century France assumed the position of teacher in the graphic fine arts that had been held earlier by Italy. Most of the modern movements in painting have radiated from Paris. England, however, claims a notable school of landscape painting headed by Constable and later by the great Turner, and the Pre-Raphaelite movement (2632) was born and died in that country. In France the revolutionary classicism of David and Ingres was followed by the Romanticism of Gericault and Delacroix, and that by the Barbizon School (2632), the realism of Courbet, the semi-classicism of Cabanel, Bouguereau, and Gérôme, and Impressionism (2632). This in the main sums up the tendencies in painting down to the Post-Impressionism, Cubism, and Futurism of our own day (2633).

- **A. Chief French Painters and Their Works:** Corot, exquisite painter of nature 892 ('Dance of the Nymphs' 1245); Millet, great painter of French peasant life 2239 ('The Angelus' 2638); Rosa Bonheur, gifted animal painter 453 ('Plowing in Nivernais' and 'The Shepherd of the Pyrenees' 453); Edouard Manet, father of the Impressionist School 2633; Jules Breton, a painter of peasants ('Song of the Lark' 421); Cézanne, Gauguin, and Matisse, of the Post-Impressionist group.
- **B. Noted British Painters and Their Works:** John Constable 2631, J. M. W. Turner 3561 ('The Fighting Téméraire' 1246); Ford Madox Brown, who largely inspired the Pre-Raphaelite School ('Chaucer Reading the First Great English Poem at Court' 703); Rossetti, Hunt, Millais, and Sir Edward Burne-Jones ('The Mill' 2638) of the Pre-Raphaelite School; G. F. Watts, painter of portraits and allegorical pictures ('Sir Galahad', frontispiece Volume 7); Sir Edwin Landseer, animal painter 1960 ('Suspense' 2641); Lord Frederick Leighton ('The Return of Persephone to Her Mother' 992, 'Wedded' 2152, 'Hit' 1523); Sir Lawrence Alma-Tadema ('Sappho Listening to the Music of a Lyre' 1534, 'A Reading from Homer' 3542).
- **C. Spanish Painters:** Zuloaga and Sorolla ('Hitching Oxen to the Boat' 2632).
- **D. Painters of the United States: 2634.** Benjamin West, historical and religious painter; John Singleton Copley, Charles Wilson Peale, Gilbert Stuart, Thomas Sully, portraitists; Thomas Cole, landscape painter, leader of the Hudson River School; William Morris Hunt, pupil of Millet; George Inness, America's first great landscape painter ('Autumn Oaks' 2637); Winslow Homer, marine painter; John La Farge; Edwin Austin Abbey ('King Arthur and His Knights' 224); James McNeill Whistler, America's most famous painter, who lived abroad and headed the Impressionist School in England; John Singer Sargent, portrait painter ('Frieze of the Prophets' 2923).

Music

I. NATURE OF MUSIC:

- **A. Physical Basis of Music: 3278.** See also the section on Sound in the Physics Outline.
- **B. Three Elements of Music: 2378.**
  - **a. Rhythm:** The regular recurrence of tone groups in which the individual notes are symmetrically arranged according to accent and time value.
  - **b. Melody:** A succession of simple tones constituting a musical phrase.
  - **c. Harmony:** The musical element that has to do with the simultaneous blending of sounds called "chords."
- **C. Written Music: 2377.**
  - **a. Staff and Notes: 2376 (picture).**
  - **b. Time in Music: 3502.**

II. SOME IMPORTANT FORMS OF MUSICAL EXPRESSION: 2378.

- **A. Suite: 2378.** A composition originally intended for one instrument, now often written for an orchestra.
- **B. Sonata: 2379.** An instrumental composition in three or four movements.
- **C. Concerto: 2379.** A composition in sonata form for a solo instrument and the orchestra.
- **D. Symphony:** A sonata for an orchestra.
- **E. Oratorio:** A semi-dramatic sacred choral work of large scope with vocal solos and orchestra accompaniment
- **F. Opera: 2584.** A musical form of drama with solos, choruses, orchestra accompaniment, scenery, and acting.
- **G. Cantata:** A composition either sacred or secular for solo voices and chorus; shorter than an Oratorio or Opera.
- **H. Anthem:** A composition in common use in church services; sometimes for full choir throughout or for two choirs, and sometimes with solo parts introduced; an organ accompaniment is usually written.

- I. **Hymn:** A form of composition used in religious services; it varies considerably in measure owing to the variety of meters used in the words.
- J. **Canon:** A composition in which one part follows another over the same notes, separated perhaps by an octave, but exactly imitating its movement.
- K. **Rondo:** A bright movement in which the principal subject keeps recurring, always in the same key.
- L. **Fugue:** A movement beginning with a subject in single notes which is given out by one part and answered by other parts in turn, the subject and counter-subjects being woven into a harmonious whole.

III. MUSICAL INSTRUMENTS: 2381.

- A. **Stringed Instruments: 2381.** Piano 2797; Harp 1589; Violin (Viola, Violoncello, and Double Bass) 3645; Guitar 1548; Mandolin 2135; Banjo 326; Ukulele 3575.
- B. **Wind Instruments: 2383.**
  - a. **Woodwind Instruments: 3781.** Flute, Piccolo, Fife, Oboe, English Horn, Bassoon, and Clarinet.
  - b. **Brasses: 1680.** French Horn, Trumpet, Cornet, Trombone, Tuba, Saxhorn, and Saxophone.
  - c. **Minor Wind Instruments: 2383:** Accordion, Bagpipe, Jew's Harp, Harmonica, Ocarina.
- C. **Percussion Instruments: 2383.**
  - a. **Drums: 1042.** Kettledrum, Bass Drum, and Snare Drum.
  - b. **Bells:** Triangle, Glockenspiel, Xylophone, Celesta, Cymbals, etc.
- D. **Orchestra: 2590.** Group Use of Instruments.

IV. HISTORY OF MUSIC:

- A. **Hebrew Music: 2376.**
- B. **Greek Music: 2376.**
- C. **Development from the 4th to the 17th century A.D.: 2377.**
  - a. **Guido of Arezzo and the Invention of the Musical Staff: 2377.**
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  - b. **George Frederich Handel: 1572.** Great master of the Oratorio.
  - c. **Christoph Willabald Gluck:** Reformer of the Opera and greatest writer of dramatic music before Mozart.
  - d. **Franz Joseph Haydn: 1609.** One of the earliest, if not the earliest, of the great masters of the symphony and the orchestra.
  - e. **Wolfgang Amadeus Mozart: 2363.** Universal genius in music, who raised all musical forms except the Oratorio and the Fugue to a point never reached before, and Comic Opera to a height "never since approached within classical limits."
  - f. **Ludwig Van Beethoven: 365.** Greatest Orchestral composer of the 19th century.
  - g. **Carl von Weber:** Founder of the Romantic School of German Opera.
  - h. **Franz Schubert: 3143.** "The first and perhaps the greatest classical song writer."
  - i. **Felix Mendelssohn: 2198.** Modern classical master, one of the earliest of moderns to appreciate and be influenced by Bach.
  - j. **Frederic François Chopin: 757.** A composer who created a new style of composition for the piano and added a new national element to music.
  - k. **Hector Berlioz:** Master of Impressionist orchestration.
  - l. **Robert Schumann: 3143.** Romanticist composer whose songs rank with those of Schubert and Mendelssohn and his "piano lyrics" with those of Chopin.
  - m. **Franz Liszt: 2026.** Pioneer of the symphonic poem.
  - n. **Giuseppe Verdi: 3628.** Greatest Italian composer of the 19th century.
  - o. **Richard Wagner: 3663.** Creator of a new form of music drama.
  - p. **Johannes Brahms:** One of the great masters.
  - q. **Peter Ilyitch Tschaikovsky: 3546.** Greatest of Russian composers.
  - r. **Antonin Dvorak:** A composer who made extensive use of folk-melodies, especially of Slavic origin.
  - s. **Richard Strauss: 3369.** Musical realist and lyric master, most sensational of modern composers.

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What musician began to compose at the age of five? 2363.

What did an injury to his hand have to do with the making of a famous German composer? 3143.

When was the violin invented? 3646.

When was the first piano made? 2797.

How did the piano get its name? 2797.

What are the three families of musical instruments? 2381.

What are the most famous doors in the world? 1457, 1848.

What great tower has a picture of the artist's dog among its sculptured figures? 1847.

How do fine arts and useful arts differ? 1242.

What Frenchman burned his furniture to make pottery? 2906.

What four horses were made twenty centuries ago? 1852.

What people were the first to leave written music? 2376.

Why do we sing "Do, Re, Mi, etc."? 2377.

What was the first musical publication in America? 2379.

How did gypsy music become great? 2026.

What is a "sonata"? 2378, 2379.

Who was the "father of English poetry"? 702.

What poet earned his way through Europe by his flute? 1483.

What poet whose fame depends chiefly on a humorous poem had a tragic life? 910.

Who was the "ploughboy poet"? 542.

What valuable manuscript was found by its author when looking for fishing tackle? 3151.

What great literary work was burned by a servant-maid? 644.

What two poets were united by "the most beautiful romance of literary history"? 517.

What English poet was the son of livery-stable keeper? 1914.

What English writer intended to reform the world, but is remembered only for his poetry? 3204.

Who was the poet who said of himself "I awoke one morning to find myself famous"? 551.

Who were the "Lake Poets"? 825.

What English poet died while fighting for the freedom of Greece? 551.

What great poem was written on the death of a poet by another poet who himself died shortly after? 3204.

What long English poem, completed after 17 years, was inspired by grief at the death of a friend? 3470.

What great religious allegory was written in prison? 534.

Who was the "real Robinson Crusoe"? 933.

What book written as a cutting satire on human nature has become a children's classic? 3406.

What English writer was leader of a literary club? 1899.

What English writer of the 18th century remains a great literary figure though his works are now little read? 1899.

To what writer was it said, "If you could make little fishes talk, they would talk like whales"? 1899.

What celebrated English novelist began work in a blacking factory? 1006.

What famous children's story was written by an old bachelor who was a professor of mathematics? 647.

What Scotch writer developed his gift of humor through trying to make his mother laugh? 333.

What famous poem on death was written by an American boy of 17? 521.

What American writer lived happily on 27 cents a week? 3492.

What famous narrative poem was based on legends of the North American Indians? 2057.

What poem saved a ship from destruction? 1674.

What American poet was also a prominent physician? 1674.

What American novel helped to bring about a war? 3368.

What novelist is called "the American Scott"? 878.

How did the "novel" get its name? 2539.

How did "Mark Twain" get his name? 3569.

Who was called "Dean of American Letters"? 1689.

How did an American essayist learn to write by going a-fishing? 543.

What was the original meaning of "pageant"? 1033 (picture).

How many actors were there in the Greek drama? 1032.

Why are the "Romance" languages so called? 3040.

What great orator of antiquity was born with an impediment in his speech? 993.

What great Spanish novelist was sold into slavery? 682.

How are religion and drama connected? 1031, 1033.

What world language did not have to be invented? 1965.

What great English story-teller waged a constant battle against death? 3355.

What popular children's book was written for a school textbook? 1957.

What Russian writer gave up his wealth and lived as a peasant? 3512.

What great German writer foreshadowed the theory of evolution? 1478.

What French writer was called the "knight errant of history"? 1375.

AGRICULTURE

It was a great day in the history of the human race, when some ancient nomad hunter first decided to settle down and begin scratching the soil with a sharp stick so it would grow crops for him. Primitive men themselves realized dimly what a momentous change this meant for them, and later generations wove legends about the god, like Osiris, or the semi-divine hero, like Cadmus, who came among men to teach them agriculture and raise them out of savagery. Gradually men added one food plant after another to their stock; they learned to domesticate animals; they grew flax and clipped the wool of their sheep that wives and daughters might spin and weave clothes for the household. Meanwhile the sharpened stick had given away to the plowshare; and the forward march of human culture was measured by the improvements in Agriculture. To this day, despite all the other vast industries that have grown up to serve us, Agriculture remains the foundation of civilization. Read first the article on Agriculture (43), then follow the Outline.

I. SOIL: 3272.

- **A. Essentials of Fertile Soil:** Moisture, Rainfall 2972; Chemical Elements 3273, 1235, 2777.
- **B. Artificial Treatment of the Soil:**
  - **a. How Moisture is Supplied:** Irrigation and Drainage 1827-8, 954, 222; Dry Farming 641.
  - **b. How Chemical Elements are Supplied:** Fertilizers 1235, 2898; Crop Rotation 2512, 48, 2511; Soil-Enriching Crops 1235 (Alfalfa 88, Clover 809, Soy Bean 3297).

Note: For soil formation and kinds of soil see the Physiography Outline page 3864.

II. DOMESTIC PLANTS:

- A. **Breeding and Propagation: 538.** Seeds and Seed Selection 3171–3, 1396 (picture), 890, 2901; Bulbs, Tubers, Rootstocks 532; Grafting 1377.
- B. **Grains:** Wheat 3730; Corn 888; Oats 2548; Rye 3102; Barley 330; Rice 3013; Buckwheat 524; Millet 2239.
- C. **Pasture and Hay Crops: 1609.** Grasses 1502, 3276, 1907; Clover 809; Alfalfa 88; Cowpeas 910; Soy Bean 3297.
- D. **Vegetables:**
  - a. **Legumes:** Beans 347; Peas 2698; Lentils 1988; Peanuts 2700.
  - b. **Bulbs, Tubers, Roots, and Rootstocks: 532.** Beets 365; Carrots 650; Parsnips 2691; Onions 2581; Potatoes 2900; Sweet Potato 3405; Turnips and Radishes 554.
  - c. **Other Vegetables:** Asparagus 234; Cabbage, Brussels Sprouts, Kale, Kohlrabi, Cauliflower, and Watercress 553; Celery 671; Cucumber 939; Eggplant (see Fact-Index); Lettuce, Okra (see Fact-Index); Pumpkins 2934; Rhubarb 3012; Spinach (see Fact-Index); Squash 3333; Tomato 3512.
- E. **Spices and Condiments: 3317.** Cloves 810; Ginger 1460; Mint 2257; Mustard 2385; Nutmeg and Mace 2544; Parsley 3319; Pepper 2723; Vanilla 3619.
- F. **Sugar 3385, 365, 2138; Coffee 820; Tea 3445; Tobacco 3508.**
- G. **Fiber Crops:** Cotton 901; Flax 1291; Hemp 1630; Jute 1905; Sisal 3244.
- H. **Fruits: 1377.**
  - a. **Common Orchard Fruits:** Apple 160; Apricot 161; Cherry 716; Mulberry 2365; Peach 2699; Pear 2701; Persimmon 2740; Plum 2840; Quince 2950.
  - b. **Small Fruits:** Blackberry 432; Blueberry 439; Cranberry 915; Currant 940; Gooseberry 1488; Grape 1501; Loganberry 2046; Raspberry 2977; Strawberry 3370.
  - c. **Tropical and Semi-tropical Fruits:** Banana 324; Breadfruit 501; Citron 769; Date 966; Fig 1237; Grapefruit 1499; Lemon 1985; Lime 2011; Mango 2135; Olive 2579; Orange 2588; Pineapple 2809; Pomegranate 2874; Raisin Grape 2974; Melons 2195.
- I. **Nuts: 2545.**
  - a. **Temperate Zone Nuts:** Butternut 548; Chestnut 718; Chinquapin 752; Hazelnut 1611; Hickorynut 1647; Pecan 2705; Walnut 3667.
  - b. **Tropical Nuts:** Almond 99; Brazil Nut 2545; Coconut 818.

III. LIVE STOCK AND LIVE STOCK PRODUCTS:

- A. **Stockraising and the Effects of Careful Breeding: 44, 49** (picture), **662, 950, 2911.**
- B. **Common Domestic Animals and Their Products:**
  - a. **Draft Animals:** Horse 1682; Mule 3300 (picture); Ass 235.
  - b. **Cattle and Hogs and Their Meat Products and By-Products: 662, 1670, 2181, 2185** (picture).
  - c. **Sheep and Wool: 3198, 3782.**
  - d. **Goats: 1476.**
  - e. **Poultry: 2908.** Chickens and Eggs 2908; Turkey 3556; Duck 1044; Goose 1487; Guinea Fowl 1547; Pigeons and Doves 2803.
  - f. **Bees and Honey:** 359, 809, 524.
  - g. **Dairying and Dairy Products:** 949. Milk 2238; Butter 543; Cheese 708.
  - h. **Other Animal Products:** Hides and Skins 1975; Feathers 2603, 1046.
- C. **Domestic Animals Peculiar to Certain Regions:** Alpaca 100; Buffalo 527; Camel 588; Llama 2039; Reindeer 2993; Yak 3827; Ostrich 2603.

IV. ENEMIES AND FRIENDS OF THE FARMER:

- A. **Animal Pests:** Gophers 1488; Groundhogs 1543; Hen-Hawks 1605; Mice 2359; Rats 2977; Mongooses 2286; Prairie-Dogs 2912; Weasels 3707. Insects: Aphids 154; Army-Worms 218; Beetles 369; Butterflies and Moths 544 (Caterpillars 660); Codlin Moth 820; Cankerworms 630; Cutworms 944, Cicadas 764, Chinch Bugs 752, Grasshoppers 1503, Hessian Flies 1645, June Bugs 1902, Potato Bugs 2902, Scale Insects 3132, Weevils 3713
- B. **Harmful Plants:** Weeds 3712; Dandelion 957; Morning Glory 2327; Poisonous Plants 2854; Thistle 3489; Rusts and Smuts 3099.
- C. **Farmers' Helpers:** Bats 345; Birds 400; Frogs 1373; Toads 3506; Moles 2278; Skunks 3246; Lady-Bugs 1955; Ichneumon Flies 1724.
- D. **Sprays and Spraying: 3330.**

V. POWER, MACHINERY, APPLIANCES:

- A. **Power:** Windmill 3749; Gas Engine 1403; Animal Power 1683, 235, 527, 2993.
- B. **Machinery: 43.** Plows 2839; Reaping Machines 2983; Threshing 3493.
- C. **Silos: 3240.**

The Picture-Story of Agriculture

The Beginnings of Agriculture 773.
How Farming was Conducted in the Middle Ages 44.
Why the Farm is the Greatest of All Factories 45.
The Modern Giant of the Grain Harvest 47.
Preparing the Soil for the Seed 47.
Bacteria—The Little Nitrate Factories 302.
How Alfalfa Farms Another Farm 89.
Preparing the Nitrates for Market 2512.
The "River System" of an Irrigated Orchard 1828.
A Typical Irrigation Plant of the West 1829.
One of the Greatest of Man-made Lakes 1830.
Water for the Thirsty Crops in Kansas 1910.
Irrigation Products of Idaho 1729.
How Colorado Gets Crops from Arid Lands 842.
The Great Roosevelt Dam 200.
In the Yakima Valley—A Man-made Paradise 3688.

For additional information on topics mentioned in these Outlines

"Elephant Butte" Dam in the Rio Grande Valley 2464.
Along One of New Mexico's Many Irrigation Canals 2465.
The Egyptian's Bucket Wheel 1827.
Ancient Egyptian "Shadoofs" and the Thirsty Fields 1093.
Why Plants Get Sick 2821.
Luther Burbank, the Plant Wizard, and Some of His Achievements 539.
Varieties of Wheat 3731.
Life on Canada's Great Wheat Farms 605.
Gathering Wheat in Russia 3089.
Asking the "Rag Doll" about the Corn Crop 889.
Oats, the Cereal with the Highest Protein Value 2549.
Varieties of Barley 331.
The Largest Grain Elevator in the World 604.
How Tibetans Grind Their Grain 3496.
The Picture Story of a Grain of Rice 3014.
"Man Power" in an Oriental Rice Field 3013.
Mrs. Igorot in Her Rice Field 2766.
The Terraced Rice Lands in the Philippines 2767.
Hawaiian Rice Field 1604.
Sturdy Pioneers of the Grass Family 1502.
A Factory Town on a Clover Root 810.
An Alfalfa Field in Mississippi 2263.
The Cowpea and Its Food 910.
The Early Life of Jack's Bean Stalk 348.
The Ancestor of the Potato 2900.
A Potato Field in Bloom 2901.
Harvesting Potatoes in Florida 2901.
The Truth About "Cabbages and Kings" 1395.
Members of the Cabbage Family 553, 554.
In Michigan's Famous Celery District 2224.
Drying Cloves in a "Garden of Spices" 3318.
A Page of Spices 3319.
Picking Peppers Near Singapore 2723.
Planting and Harvesting the Sugar Cane Crop in the Hawaiian Islands 3386.
The Most Valuable Sorghum 3276.
The Maple That Provides the Sugar Cakes 2138.
When the Sap Begins to "Run" 2139.
Coffee from Blossom to Drying Floor 821.
A Coffee Plantation in Brazil 822.
Where the Coffee Goes on Shipboard 824.
The Different Kinds of Tea 3446.
On a Japanese Tea Farm 3446.
Honor Students Picking Tea 3450.
Setting Out the Tea Plant 3450.
Raising Tobacco under Cheese Cloth 3508.
Connecticut "Wrappers" in the Field 865.
A Porto Rican Tobacco Field 2887.
It Looks Like Snow, But It's a Tobacco Field 937.
In Cotton-Picking Time 902.
Glimpses of Ireland's Famous Flax Industry 1291.
Harvesting the "Rope" Crop 1631.
A Mexican Hemp Plant 2214.
The Manila Plant and How It is Harvested 3064.
The Glory of the Orchard in Springtime 3535.
Planting a Fruit Tree 1378.
A Young Tree Before and After Pruning 1378.
The Best Way of Wrapping Root Grafts 1379.
Saving a Tree's Life 1379.
Smoking Jack Frost Out of the Orange Groves 1380.
In France's Famous Vineyards 1350.
Apple Tree in Blossom 3535.
Apricots Drying in the Sun 161.
Peaches, Ripe and Ready to Drop 2699.
Famous Peach Orchard in Michigan 2223.
A Descendant of the Little Wild Grape 1501.
Harvesting Bananas 325.
"Bread" That Grows on Trees 501.
How the Dates Have Been Trained to Come to Dinner 966.
Story of the Wasp That Helps Make Figs 1238.
Giving Olives Their Flavor 2579.
The Gray Olive Groves of the Spanish Hills 3302.
A California Orange Grove 2589.
A Pineapple Packed with Sweetness 2809.
Where the Delicious Pineapples Grow 1604.
Rocky Ford Melons 2195.
The United States Has 200,000 Acres of Watermelons Like These 2196.
A Luscious Cluster of Golden Grapefruit 1500.
Some Florida Grapefruit 1298.
Seven Varieties of Nuts 2545.
Biography of a Hickory Nut 1648.
The Pecan, The Most Valuable Nut of the South 2705.
How Flowers Turn into Peanuts 2701.
Riding the Coconuts to Mill 818.
Gathering Coconuts in the Philippines 819.
Wonders of Scientific Live Stock Breeding 49.
The Horse and His Geologic Ancestors 1682.
Different Types of Horses 1684, 1685.
Some Fine Horses of Old Kentucky 1916.
What Life is Like on a Big Nebraska Stock Farm 2430.
On an Illinois Stock Farm 1732.
A Fine Herd of Quebec Cattle 2947.
A Herd of Holstein Cattle 2263.
A Cattle Herd of South Dakota 3297.
Three Members of the Hog Aristocracy 1670.
What Alfalfa Does for Hogs 89.
The Sheep's Ancestors were Nimble Wild Creatures 3199.
Abyssinian Maned Sheep 3198.
The Pyrenees Shepherd and His Sheep 453.
French Shepherds on Stilts 1347.
Idaho Wool "on the Hoof" 1729.
The Shepherd's Intelligent Helper 1019.
The Drover's Shaggy Friend 1019.
A Swiss Boy and His Goat 1476.
Tending Goats in Sweden 3403.
What Proper Care Will Do in Egg Production 2908.
Important Breeds of Poultry 2909.
An Ideal Arrangement for Laying Hens 2910.
How to Pick a Good Hen 2910.
An Incubator and the Results It Obtains 2911.
A Whole Quacking Acre in New Jersey 2460.
An African Guinea-Fowl 1548.
Distinguished Members of the Pigeon Family 2805.
The Contented Life That Brings Rich Milk and Cream 950.
Cleanliness Means Health in the Dairy Industry 951.
Learning to Judge Dairy Cows 3653.
How to Pick a Good Dairy Cow 952.
What Good Butter is Made Of 544.
Water Buffalo of the Philippines 2765.
Asiatic Water-Buffalo 527.
The Camel—So Very Queer and Yet So Very Useful! 589, 590.
A Camel Caravan 3106.
The Llama 2039.
Reindeer, The Eskimo's "Life Insurance" 2993.
The Tibetan's Friend—The Yak 3827.
The Ostrich—The Express Train of the Desert 2603.
The Humped Cattle of India 1749.
"Roman" Oxen of Italy 1838.
When the Locusts Cover the Land 1504.
The Evil Genius of the Cotton Fields 904.
This is the Apple "Worm" 820.
The Development of the Plow 2839.
They've Plowed this Way in Persia for 2000 Years 2734.
Cutting Crops with Scythes in Poland 2856.
The Relative Value of Uncle Sam's Chief Farm Products 3591.
Fields, Orchards, and Dairy Farms in New York 2484.
Farm Life in Alberta 83.
A "Perfume" Farm in Sunny France 2728.
Farming in a Swiss Valley 3416.
Harvest in a Valley of the Tyrol 3574.
Preparing Fodder in Southern Russia 3085.
A Valley in Arabia and Its Terraced Fields 165.
Farming in Modern Egypt 46.
Farming in Australia 263, 264.

Books for the Student of Agriculture

The Call of the Land. Elisha B. Andrews.
The Lure of the Land—Farming after 50. Harvey W. Wiley.
Three Acres and Liberty. Bolton Hall.
Where Opportunity Knocks Twice. Forrest Crissey.
Opportunities in Farming. Edward O. Dean.
Hints to Homeseekers. Warren J. Geib.
Farmers for Forty Centuries—Agriculture in China, Korea and Japan. Franklin H. King.
English Farming, Past and Present. Rowland E. Prothero.
The Story of Agriculture in the United States. Albert H. Sanford.
Agricultural Economics. Henry C. Taylor.
Deep Furrows. Herbert J. Moorhouse.
Rural Organization. Walter Burr.
The Story of the Nonpartisan League Charles E. Russell.
Wheat and Woman. Georgina Binnie Clark.
The Desert and the Rose. Edith Nicholl Ellison.
Productive Agriculture. John H. Gehrs.
Agriculture and the Farming Business. Oscar H. Benson.
Intensive Farming. Lee C. Corbett.
American Irrigation Farming. Walter H. Olin.

Use of Water in Irrigation. Samuel Fortier.
Dry Farming. William Macdonald.
Dry Farming. John A. Widtsoe.
The Farmer of Tomorrow. Frederick I. Anderson.
The Farmer and the New Day. Kenyon L. Butterfield.
The Farmer's Business Handbook. Isaac P. Roberts.
Law for the American Farmer. John B. Green.
Farm Accounting. Hiram G. Scovill.
Agricultural Commerce. Grover G. Huebner.
Efficient Marketing for Agriculture. Theodore Macklin.
Agricultural Prices. Henry A. Wallace.
Farm Management. Jacob H. Arnold.
Equipment for the Farm and the Farmstead. Harry C. Ramsower.
Handy Farm Devices and How to Make Them. Rolfe Cobleigh.
Farm Mechanics. Herbert A. Shearer.
The Farmer His Own Builder. Howard A. Roberts.
The Modern Gas Tractor. Victor W. Page.
Field Management and Crop Rotation. Edward Cary Parker.
Soil Conditions and Plant Growth. Edward J. Russell.
Principles and Practice of Agricultural Analysis. Harvey W. Wiley.
Principles of Agricultural Chemistry. George S. Fraps.
The Chemistry of Plant and Animal Life. Harry Snyder.
The Chemistry of the Farm. Robert Warrington.
Soils and Plant Life. Jules C. Cunningham and W. H. Lancelot.
The Soils and Agriculture of the Southern States. Hugh H. Bennett.
Fertilizers and Crops. Lucius L. Van Slyke.
How Crops Feed. Samuel W. Johnson.
How Crops Grow. Samuel W. Johnson.
The Food of Plants. Arthur P. Laurie.
Fertilizers. Edward B. Voorhees.
Manures and Fertilizers. Homer J. Wheeler.
Manual of Weeds. Ada E. Georgia.
Manual of Vegetable Garden Insects. Cyrus R. Crosby.
The Principles of Vegetable Gardening. Liberty H. Bailey.
Vegetable Gardening. Ralph L. Watts.
Vegetable Forcing. Ralph L. Watts.
Market Gardening. Frederick L. Yeaw.
Practical Gardening. Vegetables and Fruits. Hugh Findlay.
The Sugar Beet in America. Franklin S. Harris.
The Potato. Arthur W. Gilbert.
The Sweet Potato. T. E. Hand and K. L. Cockerham.
Bush Fruits. Fred W. Card.
Manual of Fruit Insects. Mark V. Slingerland and Cyrus R. Crosby.
Fruit Growing in the Arid Regions. Wendell Paddock.
Citrus Fruits. John Eliot Coit.
The Commercial Apple Industry of North America. John C. Folger.
Strawberry Growing. Stevenson W. Fletcher.
Peach Growing. Harris P. Gould.
The Principles of Fruit Growing. Liberty H. Bailey.
Manual of Tree Diseases. W. Howard Rankin.
Manual of Fruit Diseases. L. R. Hesler.
Manual of Tropical and Sub-Tropical Fruits. Wilson Popenoe.
Manual of American Grape Growing. Ulysses P. Hedrick.
The Pruning Manual. Liberty H. Bailey.
The Farm Wood Lot. Edward G. Cheyney.
Bee Keeping. Everett F. Phillips.
The Hen at Work. Ernest Cobb.
Commercial Egg Farming from Practical Experience. George S. Hanson.
Chicken Money—How to Make Farm Flocks Profitable. Homer W. Jackson.
Success with Hens. Robert Joos.
Making Money from Hens. Harry R. Lewis.
The Mating and Breeding of Poultry. H. M. Lamon and R. Slocum.
Practical Poultry Production. Joseph W. Kinghorn.
Prairie Farmers' Poultry Book. William Osburn.
Poultry. Alton W. Richardson.
Fundamentals in Poultry Breeding. John H. Robinson.
Turkeys, Ducks, and Geese. Harold A. Nourse.
Milk and Its Products. Henry H. Wing.
The Book of Butter. Edward S. Guthrie.
Dairy Farming. Dallas S. Burch.
Productive Dairying. Robert W. Washburn.
Dairy Cattle and Milk Production. Clarence H. Eckles.
Manual of Milk Products. William A. Stocking.
The Story of Milk. Johan D. Frederikson.
Farm Dairying. Christian Larsen.
Farmers' Clean Milk Book. Charles E. North.
Dairy Chemistry. Harry Snyder.
Manual of Farm Animals. Merritt W. Harper.
The Principles and Practice of Judging Live Stock. Carl W. Gay.
The Fundamentals of Live Stock Judging and Selection. Robert S. Curtis.
Profitable Stock Raising. Clarence A. Stramel.
Profitable Stock Feeding. Howard R. Smith.
The World's Meat Future. Albert W. Pearse.
Breeding of Farm Animals. Merritt W. Harper.
Western Live Stock Management. Ermine L. Potter.
The Horse. Isaac P. Roberts.
The Training and Breaking of Horses. Merritt W. Harper.
Sheep Feeding and Farm Management. Duane Howard Doane.
Sheep Farming in North America. John A. Craig.
Pork Production. William A. Smith.
Success with Hogs. Charles Dawson.
Forty Years' Experience of a Practical Hog Man. Andrew J. Lovejoy.

Note: The book lists following the Outlines on Home Economics and Nature Study contain books for younger readers on gardening and other "first steps" in Agriculture.

Interest-Questions in Agriculture

How can you tell a squash from a pumpkin? 3333.
What gives the grapefruit its name? 1499.
Is the potato a root? 2901.
What is trepang? 3165.
Why do cows and their relatives swallow their food first and chew it afterwards? 3082.
In what season of the year do lemons ripen? 1986.
Erasers, salad oil, dynamite, "red rubber" sponges, postage stamps, battleships, cattle feed, syrup, tobacco pipes, stiff collars—what common cereal do these make you think of? 890.
Why would the earth become sterile without the earthworm? 1066.
How long does a hen's egg take to hatch? A duck's egg? 408.
How large a load can a camel carry and how far can it travel in a day? 591.
What orchard tree does not come into full bearing until it is 30 years old? 2579.
What bird lays a 3-pound egg? 2603.
How does the palm tree get its name? 2647.
What familiar nuts grow underground? 2700.
Why are bobolinks welcomed by farmers in the North and dreaded by farmers in the South? 446.
What American tree is closely related to the breadfruit tree? 501.
Why does the horse have only one toe on each foot? Where were there once four-toed horses? 1683.
How did one coffee tree supply the world? 822.
Why must coffee be grown 1,200 to 2,000 feet above sea level? 822.
Why are armies of ants welcome on a coffee plantation? 822.
To what is the flavor of a spice due? 3318.
How does man get a milk cow and a beef from the same stock? 662.
What does it mean to belong to the cabbage family? 553.
How does the fruit grower keep Jack Frost out of his garden? 1380.
How has man changed the shape and character of sheep? 3199.
What plant is harvested from July to November? 902.
What does a farmer mean by "heavy" soil? 3273.
How were the grape vines of France threatened and saved by American vines? 1501.
Why has the market supply of blueberries always been from wild bushes? 439.
How is soil enriched by certain plants? 2511.
Do the sweet potato and the Irish potato belong to the same family? 3405.
Why are the tea plants kept pruned? 3445.
Why did our great-grandmothers hold up their hands in horror at the idea of eating a tomato? 3512.
What fruit of North America is picked green and packed away to ripen? 2701.
What accounts for the small size of the Shetland pony? 1685.
How do bees carry the pollen they collect? 360.
How do the feathers of a pigeon differ from those of an owl? 1228 (picture).
What fruit cannot be grown without the aid of an insect? 1237.
What familiar fruit comes from the same genus of trees as the India-rubber tree? 1237.
What familiar orchard fruits are closely related to the rose? 3066.
Why do cows pull grass instead of cutting it off with their teeth? 663.
What common article of food comes from the pith of palms? 3104.
What common fiber plant grows its male and female flowers on separate plants? 1630.
What insect sometimes costs the farmers of the Mississippi Valley $60,000,000 in a single year? 752.
Are all hawks enemies of the farmer? 1605.
How is it possible to develop new varieties of fruits and vegetables? 538.
Why can cattle eat rough feed that horses cannot? 663.

INDUSTRIES *and* APPLIED SCIENCES

INDUSTRIES and Applied Science form the very backbone of modern civilization. A complete study of their field would encompass the whole fabric of our practical daily lives and would branch out into such subjects as Geography, Botany, Zoölogy, the Physical Sciences, the Social Sciences, and many other departments of knowledge. This Outline is intended merely as a general survey of the chief materials of industry and of the principal ways in which they are obtained and used, together with a summary of the important sources of power and methods of transportation and communication. The list of pictures dealing with industries and inventions which is attached to this Outline will be found of unusual importance and value to those seeking clear and concise information on the subjects in question.

I. RAW MATERIALS AND HOW THEY ARE OBTAINED:

- **A. Minerals:**
  - **a. Mining: 2248, 2247.**
    - **1.** Coal 811; Petroleum 2749; Natural Gas 1407.
    - **2.** Common Metals: 2201; Iron 1817; Copper 881; Lead 1973; Tin 3504; Zinc 3839; Aluminum 104; Antimony 150; Arsenic 220; Bismuth 428; Cobalt 816; Manganese 2135; Mercury 2199; Nickel 2506; Tungsten 3548.
    - **3.** Precious Metals: Gold 1479; Silver 3240; Platinum 2831; Radium 2959.
    - **4.** Gems: 1409. Diamonds 1001.
    - **5.** Other Common Minerals: Borax 464; Salt 3115; Sulphur 3389; Graphite 1502; Potash 2898; Asphalt 234.
  - **b. Quarrying: 2943.**
    - **1.** Building Stones: Granite 1497; Marble 2144; Slate 3248; Limestone 2010; Sandstone 3123.
    - **2.** Other Minerals: Clay 783; Sand 3123; Gypsum 1554; Talc 3430; Chalk 685; Asbestos 225; Mica 2219; Emery 1142.
- **B. Plant Materials:**
  - **a. Food Crops and Fibers:**
    - **1.** Grains 3730; Fruits 1377; Vegetables 1397; Plants Grown for Sap 3385, 365, 2138; Spices 3317; Nuts 2545; Sago 3104.
    - **2.** Cotton 901; Flax 1291; Hemp 1630; Jute 1905; Sisal 3244.

    Note: A more detailed survey of Food and Fiber plants will be found in the Outline on Agriculture.
  - **b. Timber: 2076, 1327, 3530.**
    - **1.** Woods: Alder 85, Ash 225; Beech 364; Birch 399; Buckeye 523; Butternut 548; Cedar 670; Cherry 716; Chestnut 718; Cypress 946; Ebony 1073; Elm 1138; Eucalyptus 1186; Fir 1248; Hickory 1647; Holly 1673; Ironwood 468; Juniper 1903; Larch 1963; Linden 2018; Locust 2045; Mahogany 2124; Mangrove 2135; Maple 2138; Mesquite 2201; Oak 2547; Olive 2580; Paper Mulberry 2366; Pine 2807; Poplar 2880; Quebracho 2677; Rosewood see Fact-Index; Sequoia 3175; Satinwood 1748; Sandalwood 3123; Spruce 3332; Sloe 3251; Sycamore 3424; Tamarind 3432; Tulip Tree 3547; Teak 3451; Walnut 3667; Willow 3742.
    - **2.** Forests and Forestry Protection: 1327.
  - **c. Some Other Plant Materials:** Tobacco 3508; Balsam 1248; Bamboo 323; Camphor 594; Cane 1502; Cellulose 673; Cork 887; Coconuts 818; Dye Woods 1049 (Butternut 548, Hickory 1647, Walnut 3667, Logwood 2046); Gutta-percha 1554; Gums 1552; Resins 2997; Rubber 3071; Tagua Nuts 1854; Waxes 3706; plants used for Perfumes: 2728, 2385, 3123.
- **C. Animal Materials:** Domestic animals, which are the greatest source of animal materials, are treated in the Outline on Agriculture.
  - **a. Hunting, Trapping: 3527.**
    - **1.** Furs: 1389; Badger 304; Beaver 356; Bear 349; Chinchilla 752; Ermine 1174; Fox 1336; Hares and Rabbits 1584; Leopard 1988; Lynx 2087; Marten 2155; Mink 2251; Mole 2278; Muskrat 2384; Oppossum 2585; Otter 2605; Raccoon 2951; Seal 3166; Skunk 3246; Squirrel 3333; Tiger 3498, Wolf 3774; (Hudson's Bay Company 1692).
    - **2.** Ivory and Bone 1853, 452–3; Elephant 1130; Hippopotamus 1651; Walrus 3668.

3. Perfume: 2728. Musk Deer 2383; Musk Ox 2383; Crocodile 923.
4. Feathers: 1229. Egret 3365; Paradise Birds 2676; Grebe 1515; Eider Duck 1046.

b. Fishing:

1. Fish: 1271, 1280. Bass 345; Catfish 662; Cod 820; Eel 1089; Flatfish 1289; Haddock 1558; Halibut 1565; Herring 1645; Lamprey 1958; Mackerel 2102; Muskellunge 1278; Octopus 943; Perch 2726; Pike and Pickerel 1278; Salmon 3113; Sardines 3126; Shad 3188; Shark 3197; Sturgeon 3374; Sunfish 3396; Swordfish 3423; Tarpon 3438; Trout 3545; Tunny 3552; Whitefish 3733.
2. Sea Mammals: Whale 3723; Porpoise 2884; Seal 3166; Walrus 3668.
3. Water-Dwelling Reptiles: 2997. Turtle 3562; Terrapin 3563.
4. Shellfish: Oyster 2612; Clam 782; Crab 912; Crawfish 915; Lobster 2041; Shrimp 3225.
5. Other Sea Products: 1014. Coral 884; Pearls 2703; Sponges 3328.

c. Raw Materials Used for Cloth Making: Silk 3234; Wool 3782; Alpaca 100; Goat's Hair 1476; Camel's Hair 590; Other Hair 1560.

d. Other Animal Materials: Honey 362; Cochineal 817, 3133; Ambergris 2728, 3726; "Lac" 1954.

II. POWER AND HOW IT IS APPLIED:

A. Natural Sources of Power:

a. Fuels Used in Generating Power: Wood 399, 597, 719, 2135; Charcoal 688; Wood Alcohol 84; Coal 811; Coke 824; Peat 2704; Petroleum 2749; Kerosene 2749; Gasoline 1408; Gas: Illuminating Gas 1406, Natural Gas 1407, Acetylene Gas 7.

b. Water 3694; Air 52 (Wind 3750); Electricity 1108.

c. Animal Sources of Power: see Outline on Agriculture.

B. How Natural Sources of Power are Put to Work:

a. Fuels: Steam Engine 3348; Gas Engine 1403.

b. Water: Water Wheel 3696; Hydraulic Machinery 1708; Water Turbine 3553.

c. Air: Windmill 3749; Pneumatic Appliances 2846; Brakes 492.

d. Electricity: Dynamos and Batteries 1050.

e. Animals: Agricultural Machinery, Carriages, Wagon: 46, 1684.

Note: Animals differ from all other agencies of power in that they both produce power and put it directly to work.

III. TRANSPORTATION AND COMMUNICATION: 3524.

A. Land Transportation:

a. Roads and Streets 3023; Bridges 505; Tunnels and Subways 3550; Railroads 2962.

b. Vehicles: Wagons and Carts 45 (picture), 47 (picture); Sleds 3085 (picture); Bicycles and Motorcycles 391; Automobiles 274; Street Cars, Elevated Trains, Subway Trains 3371; Railway Cars 2965; Locomotive 2043.

B. Water Transportation:

a. Waterways: Rivers 3022; Canals 625; Lakes 1957; Ocean Routes 255 (map), 2624 (map), 2420.

b. Craft: Boats and Canoes 441; Motor Boats 2357; Ships 3207; Submarines 3375.

C. Air Transportation: Balloons 310; Airplanes 54.

D. Communication: Telephone 3458; Telegraph 3454; Wireless 3758; Cables 556.

IV. MANUFACTURING:

A. Metal-Working:

a. Industries Concerned with the Extraction of Metals: Metallurgy 2201, 944, 2200; Assaying 236; Smelting and Refining 882, 1820; Use of Furnaces 1382.

b. Industries Concerned with Shaping and Finishing of Metals: Forging 1826; Casting 1820; Lathing, Punching, Drilling, Planing, Sawing, Cutting, Pressing, 3514 (Tools); Rolling 1826; Welding 3716; Electroplating 1125.

c. Metal Products:

1. Chief Metals and Their Uses: Iron and Steel Products 1825; Aluminum 104; Copper 881; Lead 1973; Tin 3504; Zinc 3839; Nickel 2506; Gold 1482; Silver 3242; Platinum 2831.
2. Machinery: See list of machines under the entry "Machinery" in the Fact-Index.
3. Other Devices Made of Metal: Armor-Plate 216; Bells 377; Buttons 548; Cables 556; Cans 632; Cannon and Firearms 633, 1252; Calculating Machinery 571; Cash Registers 653; Clocks and Watches 797; Electrical Devices 1115; Knives and Forks 1937; Lamps 1958; Locks and Keys 2042; Machine Guns 2097; Meters 2204; Nails 2387; Pens 2709; Pins 2807; Plows 2839; Rails 2964, 1822–23 (pictures); Steamship 3212; Stoves 3368; Traps 3527; Typewriters 3573; Wire 3757.

B. Building Materials: Iron and Steel 1815, 529; Lumber 2076; Limestone 2010; Granite 1497; Sandstone 3123; Marble 2144; Slate 3248; Concrete 856; Cement 674; Brick and Tile 502.

C. Wood Products and Associated Industries:

a. Furniture Making 1383; Veneer 3620.

b. Other Products: Airplane Parts 2124, 3333; Baskets and Boxes 399; Bats and Clubs 3743, 3251; Bows 3830; Cask Staves 2548; Charcoal 688; Gun Stocks 548, 3667; Handles 225, 3251, 3743; Paper Pulp 523, 3333, 3743; Pencils 1903, 2712; Ships and Ship Parts 2548, 3332, 3451; Ties and Posts 719, 946, 3176; Trestles and Wharves 512, 2135, 3176.

c. Associated Industries: Glue 1475; Lacquer 1954; Paints and Varnishes 2642.

D. **Ceramic Industries:** Pottery 2903; Porcelain and China 2881; Enameled Wares 1145; Glass 1471.
E. **Cloth, Clothing, and Fiber Manufacturing:**
  a. **Processes in Cloth Making:** Spinning 3326; Weaving 3326, 904, 3434, 3239 (picture), 1949; Knitting 1935; Felting 1231; Bleaching 435; Mercerizing 2198; Dyeing 1049, 814, 1777, 2046, 104.
  b. **Products:**
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    2. Other Products: Thread 3493; Rope and Twine 3063; Lace 1949; Linoleum and Oilcloth 2018; Rugs and Carpets 3077; Tapestry 3433.
  c. **Clothes:**
    1. Designing (Costume) 897; Sewing 3183; Embroidering 1140.
    2. Garments 805 (using Cloth 804, Furs 1389, Lace 1949, Button 548); Hats and Caps **1597** (Feathers 1229, 2603, 3365, 2676, 1515); Gloves 1474; Knitted Wear 1935.
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  a. **Leather Making: 1975.** Cowhide, Calfskin 1977; Sheepskin 1977; Chamois 686; Goatskin 1477; Pigskin 1671; Shagreen 236; Walrus 3668; Buffalo 527; Alligator 98; Crocodile 923.
  b. **Chief Products:** Gloves 1475; Shoes 3220; Book Binding 458; Parchment and Vellum 2667.
H. **Food Manufactures:**
  a. **Flour Milling 1301; Baking 496; Breakfast Foods 501; Macaroni 2093.**
  b. **Sugar and Sugar Products:** Beet 3388, and Cane 3385; Maple Sugar 2141 (pictures); Candy **628.**
  c. **Chocolate 755; Coffee 820; Tea 3445; Spices, Condiments, Flavorings 3317; Vinegar 3644; Salt 3115.**
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  e. **Other Food Manufactures:** Oleomargarine 2577; Baking Powder 305; Yeast 3828; Fats and Oils 1225.
  f. **Preserving of Food:** Canning 631, 3113, 3126, 1645; Drying or Dehydration 986, 2239, 2928, **2974,** 161; Refrigeration or Cold Storage: 825, 2989.
  Note: Although the Cold Storage Industry cannot be called a manufacturing industry, it is of so much importance that it deserves mention here.
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J. **Printing: 2916.**
  a. **Printing Processes:** Electrotyping 1125; Engraving 1168; Stereotyping 3355; Type Operating **3572;** Linotype 2019; Monotype 2303.
  b. **Bookmaking 455; Newspapers 2472; Magazines and Periodicals 2475.**
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V. **ENGINEERING AND ENGINEERING CONSTRUCTION: 1149, (Surveying 3397).**
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  D. **Sanitation:** Waterworks 3701; Aqueducts 164; Reservoirs 954; Plumbing 2840; Sewerage 3183.
  E. **Highway and Waterway Construction:** Roads 3023; Railroads 2962; Tunnels and Subways **3550;** Bridges 505; Harbors and Docks 1578; Dikes (see Fact-Index); Jetties 1888; Canals 625.
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Shell-Fish Industries. J. L. Kellogg.
America's Power Resources. Chester G. Gilbert.
Power and Power Transmission. E. W. Kerr.
Development and Transmission of Power. W. C. Unwin.
Steam Power. Clarence F. Hirshfield and T. C. Ulbricht.
Elements of Electricity. Robert A. Millikan and E. S. Bishop.
Home Study Course in Practical Electricity. William H. Radcliffe.
Modern Railway and Steamship Lines. William J. Jackman.
The Paths of Inland Commerce. Archer B. Hulbert.
Railroad and Street Transportation. Ralph Fleming.
The Telephone and Telephone Exchanges. J. E. Kingsbury.
Wireless Telegraphy. J. Zenneck.
Opportunities in Engineering. Charles M. Horton.
Engineering as a Career. F. H. Newell and C. E. Drayer.
Practical Surveying for Surveyors' Assistants, Vocational, and High Schools. Ernest McCullough.
Mechanics, Indoors and Out. Frederick T. Hodgson.
Applied Mechanics. Alfred P. Poorman.
Building Materials. George A. T. Middleton.
Materials of Construction. A. P. Mills.
Iron and Steel. H. P. Tiemann.
What You Should Know When Building a Little House. Charles E. White.
Building Construction. C. F. Dancaster.

Ventilation, Heating, and Lighting of Dwellings. J. W. Thomas.
Heating and Ventilation of Buildings. Rolla C. Carpenter.
Artificial Light; Its Influence upon Civilization. Matthew Luckiesh.
The Art of Roadmaking. Harwood Frost.
Bridge Engineering. J. A. L. Waddell.
Tunneling. Charles Prelini.
Railroad Construction. C. L. Crandall and Fred A. Barnes.
River and Canal Engineering. E. S. Bellasis.
Artificial Waterways and Commercial Development. A. B. Hepburn.
Water Supply. W. P. Mason.
Sewerage Disposal. L. P. Kinnicutt, C. E. A. Winslow, and R. W. Pratt.
Principles of Irrigation Engineering. F. H. Newell and Daniel W. Murphy.
Irrigation and Drainage. F. H. King.
Furniture Making. R. S. Bowers.
Materials of the Painters Craft. A. P. Laurie.
Painters' Colors, Oils, and Varnishes. G. H. Hurst.
Clay and Pottery Industries. J. W. Mellor.
Glass and Glass Manufacture. Percival Marson.
A Short Account of Explosives. Arthur Marshall.
The Chemistry of Dyestuffs. M. Fort and L. L. Lloyd.
The Chemistry of Commerce. Robert Kennedy Duncan.
Opportunities in Chemistry. Ellwood Hendrick.
Outlines of Industrial Chemistry. Frank Hall Thorp.
A Book on Vegetable Dyes. Ethel M. Mairet.
Yarn and Cloth Making. Mary L. Kissel.
Textiles. Paul H. Mystrom.
Cotton. George Bigwood.
Wool. Frank Ormerod.
All About Dress. John Bray.
Scientific Hat Finishing and Renovating. Henry L. Ermatinger.
Rubber—Its Sources, Cultivation, and Preparation. H. Brown.
Rubber and Rubber Planting. R. H. Locke.
Leather, from the Raw Material to the Finished Product. K. J. Adcock.
The Manufacture of Boots and Shoes. Frank Y. Golding.
Bookbinding and the Care of Books. Douglas Cockerell.
Paper, Its History, Sources and Manufacture. H. A. Maddox.
Practical Paper Making. George Clapperton.
Modern Printing. John Southworth.
The Printed Book. Harry G. Aldis.
Making a Newspaper. J. L. Given.
The American Newspaper. J. E. Rogers.
Commercial Photography. George W. Hance.
The Science and Practice of Photography. John R. Roebuck.
Picture Play Photography. H. M. Lomas.
Motion Picture Operation. H. C. Horstmann and V. H. Tousley.
How Motion Pictures are Made. Homer Croy.
Toys and Toy Making. George F. Johnson.
Tobacco from the Grower to the Smoker. A. E. Tanner.
The Story of Drugs. Henry Corbin Fuller.
Food Industries. T. Hermann Vulté and Sadie B. Vanderbilt.
Wheat and Its Products. Andrew Millar.
Modern Practical Baking. William H. Brooks.
Story of Sugar. G. T. Surface.
Coffee: Its History. J. M. Walsh.
Coffee; Its Culture and Commerce in All Countries. Charles G. W. Lock.
Tea: Its History and Mystery. J. M. Walsh.
Tea Blending as a Fine Art. J. M. Walsh.
The Modern Packing House. F. W. Wilder.
Spices: Their Botanical Origin, Their Chemical Composition, Their Commercial Use. Joseph K. Jank.
The Canning of Fruits and Vegetables. Justo P. Zavalla.
Practical Refrigeration. Madison Cooper.

Books That Tell How to Do Things

Toy-Making in School and Home. R. K. Polkinghorne and M. I. R. Polkinghorne.
Tin Can Toys and How to Make Them. William Carrie.
The Home Handy Book. A. Frederick Collins.
Things Boys Like to Make. Edwin W. Foster and John F. Woodhull.
Practical Things with Simple Tools. Milton Goldsmith.
Inventing for Boys. A. Frederick Collins.
Mechanics of the Household. Edward S. Keene.
How to Make Things. Archibald Williams.
Carpentry and Mechanics for Boys. A. Neely Hall.
Carpentry for Beginners; Things to Make. John D. Adams.
Amateur Joinery in the Home. George Ashdown Audsley and Berthold Audsley.
Carpentry and Woodwork. Edwin W. Foster.
Woodwork for Beginners. Ira Samuel Griffith.
Bird Houses Boys Can Build. Albert F. Siepert.
The Amateur Mechanic. A. Frederick Collins.
The Boy Mechanic; How to Construct Things which Delight Every Boy. Popular Mechanics.
The Boy's Book of Mechanical Models. William B. Stout.
Tool and Die Design for Beginners. Frank E. Shailor.
Essentials of Drafting. Carl L. Svenson.
Shop Practice for Home Mechanics. Raymond F. Yates.
Elementary Machine Shop Practice. T. J. Palmateer.
Elementary Forge Practice. R. H. Harcourt.
Forging of Iron and Steel. Allyn Richards.
Plain and Ornamental Forging. Ernest Schwarzkopf.
Working in Metals. Charles C. Sleffel.
The New Tinsmith's Helper and Pattern Book. Hall V. Williams.
The Boys' Book of Engine-Building. A. Frederick Collins.
The American Boys' Engineering Book. A. Russell Bond.
Second Boys' Book of Model Aeroplanes. Francis A. Collins.
Practical Concrete for the School and Home. Walter F. Beyer.
Handicraft for Handy Girls. Dorothy Perkins.
The Little Girl's Knitting and Crochet Book. Flora Flickmann.
A Handbook of Elementary Sewing. Etta Proctor Flagg.
Needlecraft in the School. Margaret Swanson.
A Guide to Laundry Work. Mary D. Chambers.
Secrets of Dry Cleaning. Leslie E. Foster.
The High School Cookery Book. Grace Bradshaw.
Candy-Making at Home. Mary M. Wright.
The Candy Cook Book. Alice Bradley.
Home Canning, Drying, and Preserving. Louise A. Andrea.
Successful Canning and Preserving. Ola Powell.
How Children Learn to Draw. Walter Sargent and Elizabeth E. Miller.
Industrial Arts Design. William H. Varnum.
Batiks, and How to Make Them. Pieter Mijer.
Hand-Wrought Jewelry. H. R. Sorensen and S. J. Vaughan.
An Introduction to the Art of Basket-Making. Thomas Okey.
Basket-Making. D. Collier.
How Paper Boxes are Made. Robert F. Salade.
Bookbinding as a Handwork Subject. John Halliday.
The School Printshop. Katherine M. Stilwell.
Boys' Playbook of Science. John H. Pepper.
The Amateur Chemist. A. Frederick Collins.
The Boys' Book of Chemistry. Charles R. Clarke.
The Child's Food Garden. Evrie Kilpatrick.
Gardening for Little Girls. Olive Hyde Foster.
The Boys' Camp Manual. Charles K. Taylor.
Shooting for Boys. A. Frederick Collins.
How Sails are Made and Handled. Charles G. Davis.
The Boys' Book of Canoeing and Sailing. Warren H. Miller.
Small Boat Building. H. W. Patterson.
Electrical Apparatus Making for Beginners. Albert V. Ballhatchet.
American Boy's Book of Electricity. Charles H. Seaver.
Electrical Construction. Walter B. Weber.
Easy Lessons in Wireless. A. Frederick Collins.
How to Become a Wireless Operator. Charles B. Hayward.
The Elementary Principles of Wireless Telegraphy. R. D. Bangay.
Radio-Telephony for Everyone. Laurence M. Cockaday.
The Radio Amateur's Hand Book. A. Frederick Collins.
Radio Receiving for Beginners. Rhey T. Snodgrass and Victor F. Camp.

THE HOW AND WHY OF THINGS

Interest-Questions on Many Subjects

Why do men's coat collars have a nick in them? 898.
What is the peculiar property of type metal that distinguishes it from most other substances? 99.
Why are coins not made of pure gold and silver? 99.
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How does the white of an egg settle coffee? 83.
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What mineral is woven into cloth? 225.
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Why is the sky blue? 52.
Why is coffee roasted? 823.
What sort of fish is usually sold in the United States as "sardines"? 3126.
What are shoe-buttons made from? 550.
How does a barometer help forecast the weather? 333.
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Why is winter colder than summer? 1063.
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What becomes of all the old tin cans? 631.
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What is the difference between a musket and a rifle? 1254.
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Why must a deep sea diver come up slowly? 1014.
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Why does dew not form on cloudy nights? 1000.
Why was $100,000 saved by setting the clocks ahead? 969.
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Why are many great dams horseshoe-shaped? 954.
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Why does a piece of iron get hot when it is hammered? 1618.
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What is "mineral wool"? 1472.
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Why, if mercury is a liquid, will it not wet paper? 2199
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What wood is dug out of the ground? 2201.
What machine has a jacket to keep it cool? 1405.
Why is salt mixed with the ice used in freezing ice cream? 1362.
Why are sky-scrapers seldom damaged by lightning? 2007.
What are gunny-sacks made of? 1905.
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Why are there certain kinds of wool which will not burn? 1263.
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How can a flame manufacture water? 1710.
How can boiled water be kept from tasting "flat"? 1715.
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Is the American "nickel" made of nickel? 2506.
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Why do sailors' blouses have a bit of white showing at the neck? 2426.
Why is the sea salt? 2554.
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How did a man become famous through a soap bubble? 3267.
Why has a bubble two surfaces and a drop of water only one? 3267.
Why did the fruit growers of California import Australian lady-bugs? 3132.
If you plant a seed upside down, will the root grow upward instead of downward? 348.
Why would we have no fine silk without the mulberry tree? 2365.
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If there were no horses in America when Columbus discovered it, where did all the wild mustangs that used to roam the western plains come from? 1684.
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From what fish do we get caviar and isinglass? 3374.
How did an insect cost France two billions of dollars in a few years? 1501.
Why are hollyhocks less beautiful now than in your grandmother's youth? 1674.
What insect might be said to "use tools"? 3693.
If a black guinea-pig is mated with a white, what color will the off-spring be? 1642.
How fast can a homing pigeon fly? 2804.
Where do clams grow so large that one of them would make a hundred gallons of chowder? 782.
How far can a rattlesnake reach when it strikes? 2978.
What snake can throw its poison from a distance? 817.
How do pearl divers in the South Seas kill an octopus when it clutches them? 943.
What deer produces a valuable material used in perfumes? 979.
Why is the barberry banished by law in some states? 3101.
How far can a jack-rabbit leap? 1583.
Which can run faster—a man or a hippopotamus? 1651.
What bird builds nests six feet across? 1053.
How did the expression "crazy as a loon" originate? 2062.
Which grows larger, the lion or the tiger? 2024.
Where do crabs climb trees? 914.
Can the porcupine "shoot" its quills at an enemy? 2883.
Why isn't spiders' silk used for making cloth? 3325.
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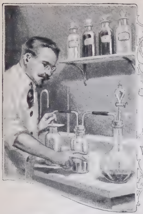
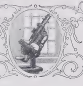
How does a chameleon change its color? 685.
What animal has been known to tunnel 75 yards in one night? 2278.
What plant has blossoms that open at night and wither in daylight? 563.
Does an earthworm suffer when the fisherman puts it on a hook? 1067.
Why has the penguin lost its power of flight? 2716.
Why are buzzards protected by law in the South? 550.
Where did the camellia get its name? 591.
Why are some canaries fed red pepper? 627.
What causes the phosphorescence of the ocean? 2776.
Why can't a snake close its eyes? 3257.
What animal grows out again if it is cut in half? 1067.
Why does the hepatica develop its leaves early? 1076.
Can a snake leap from the ground? 3257.
Why is cuttlefish bone put in canary cages? 627.
What animal is hatched in the sea and then travels great distances up rivers and overland to fresh water? 1089.
If a boy were as good a jumper in proportion to his size as the grass-hopper, how high could he leap? 1503.
Why was the English sparrow imported into the United States? 630.
If a tiger should attack a buffalo which would probably win the fight? 527.
Why is castor oil the best lubricant for airplane engines? 657.
What animal lays as many as 60,000,000 eggs a year? 1090.
Can any animal remain standing up continuously for years? 1127.
A horse as small as a cat—was there ever such an animal? 1683.
Why do some eucalyptus trees turn their leaves edgewise to the sun? 1207.
Why wouldn't a white cat with pink eyes make a good mouser? 658.
Where do ferns and lilies and tulips grow as large as trees? 265.
Why is spruce the best wood for airplane construction? 3333.
What animal holds the speed record for running? 146. The distance record for flying? 1549.
What birds have had a monument erected to them? 1550.
What animal can eat its own weight in food every day? 402.
What animal can eat 86,000 times its original weight in 56 days? 660.
What plants are so small that 7,000 of them could lie side by side on the head of a pin? 303.
How does a bat's wing resemble your hand? 1572.
Can a hare run faster up hill or down? 1583.
Is it correct to refer to all insects as "bugs"? 1787.
What causes decay? 302.
What insect lives its entire life inside the body of another insect? 371.
Do living beings ever originate from non-living matter? 398.
What bird has the greatest wing spread? 80.
Does the century plant bloom only once a century? 42.
What four-footed animal can jump over a man on horseback? 1908.
What fish sucks the blood of other fish? 1958.
What animal can change its shape at will? 118.
What plant group contains man's best friends and worst enemies? 302.
What plant sometimes grows a foot a day? 323.
How many kinds of animals have scientists classified? 127.
What insects build houses as high as a two- story house? 143.
What animal wears a flexible "coat of mail"? 211.
What tree covers such an area that it could shelter 7000 people under its branches? 329.
What sea animal propels itself by sucking in and squirting out water? 3133.
Why are both eyes of the flatfishes on the same side of the head? 1290.
What living trees are believed to be 5000 years old or more? 3176.
What fish has to turn on its back to seize its prey? 3196.
Why does the shrike hang its victims on thorn or fasten them in some other way before tearing them to pieces? 3225.
What insect stores away paralyzed caterpillars to feed its young? 3692.
What animal strikes the ground with its hind feet ahead of its fore feet when running? 1583.
How far can a lion spring? 2024.
What animal can look over its shoulder with one eye and straight ahead with the other? 685.
What animal has a tongue half as long as its body? 685.
Why does red clover grow thickest where there are cats? (See text facing 358).
What insect "rows himself through the water upside down"? 3696.
Does handling toads cause warts? 3506.
How many beats a second does a fly's wing make when it is flying? 1313.
What water plant has leaves large and strong enough to support a man? 3699.
What animal sometimes sleeps standing up and leaning against a tree? 1464.
How far can the flying-fish fly? 1314.
What bird has a cylindrical tongue? 3780.
What worms may grow as long as 30 feet? 3813.
How fast can a duck fly? 1044.
Where have monkeys been trained to tend sheep? 2292.
How does a clam betray itself to a fisherman? 782.
What is the tallest living animal? 1463.
Of what animal do we eat only the muscle? 3134.
How large is a crocodile when it is first hatched? 923.
Why would Africa probably have been conquered for civilization ages ago but for the mosquito? 2334.
What disease is transmitted by the tsetse fly? 3546.
What is the best wood for making gun-stocks? 3667.
Why are cassowaries rarely found in zoos? 654.
What is the wood of the buckeye used for? The nuts? 523.
What are the best woods for making tool handles? 225.
What wood makes the best charcoal for gunpowder? 85.



PHYSICAL SCIENCES



UNDER the name "Physical Sciences" are included those branches of knowledge which deal with the structure and behavior of the "dead" matter of the universe, that is, matter considered apart from "vital" or life energy and coördination. The principal physical Sciences are **Physics, Chemistry,** and **Astronomy,** but there is no sharp line dividing one from the other, and indeed there is in practice no sharp line dividing the Physical Sciences from the Biological Sciences, for we have such departments as Biological Chemistry or Biochemistry, as it is sometimes called. Because of the countless technical principles involved in the Physical Sciences, it is obviously impossible to present here anything more than a brief survey of the primary points in each field.

Physics

I. **DEFINITION:** Because any short definition would include other sciences, Physics is best defined by stating its basic doctrines and the goal it strives to attain.
  - A. **Nature of the Physical Universe:** Physics assumes that the physical universe consists of three elements: **(1) Matter,** the substance of tangible objects; **(2) Ether,** an elastic intangible substance pervading all space, providing, so to speak, a medium through which force is transmitted across space; and **(3) Electricity,** a force of unknown nature which, generally speaking, is the "driving force" of the universe.
  - B. **Character of Physical Laws:** Physics assumes that Matter, Ether, and Electricity act together according to definite, discoverable laws. Physics therefore has for its goal the explanation, with mathematical exactness and in conformity with these laws, of all phenomena of the inanimate universe.

  Note: Physicists now are trying to reduce this simple concept of the physical universe still further, by combining Electricity and Matter in a single concept which considers Matter a form of Electricity (256). A considerable number also are trying to explain the physical phenomena of the universe without using the idea of an Ether. Both movements are still too highly theoretical to be discussed in this Outline.

THE BASIC LAWS OF PHYSICAL ACTION

I. **THE LAW OF CAUSATION:** Physics assumes that everything which takes place in the physical universe is the result of causes, exactly proportional to the effect produced.

II. **NEWTON'S THREE LAWS OF MECHANICAL ACTION: 2190.**

III. **THE "CONSERVATION OF ENERGY" LAW: 1148.** This doctrine states that, in any physical phenomenon, energy is only transformed, and never is lost.

IV. **THE "CONSERVATION OF MASS" LAW: 2786.** This principle holds that, in any physical phenomenon, matter is merely transformed and is never destroyed.

NATURE AND PROPERTIES OF MATTER

I. BASIC PROPERTIES OF MATTER:
  - A. **Extension or Volume:** Every material thing in the world takes up some room in it.
  - B. **Mass:** The quantity of matter in a body. This is indicated by the amount of force necessary to produce a given amount of motion in the body in a given time. The Mass of a body is constant. It is the Mass of a body which gives it Inertia (see below). The symbol used in physical formulae to indicate Mass is **m.**
  - C. **Weight:** The downward pressure which a body exerts in response to **Gravity.** Weight depends both upon the *force of gravity* at the place of measurement, and the *mass* of the article weighed. If a body of given mass be placed at different distances from the center of the earth, its weight will vary (1508), while its mass remains constant.
  - D. **Density:** The Weight of a substance per unit of Volume. When we say that lead is "heavier" than cork, we mean that it has a greater Density, or, in other words, that a cubic inch of lead weighs more than a cubic inch of cork.

E. Inertia: The tendency to "stay put," either motionless or in straight-line motion at uniform speed, until some definite force causes a change. Newton's first law of motion (2190) is sometimes called the Law of Inertia.

F. Other Properties: Elasticity, Plasticity, Cohesiveness, Adhesiveness, Malleability, Ductility, Hardness.

II. STATES OF MATTER: Physics considers only three states, or conditions in which matter may be found—**Solid, Liquid,** and **Gas.**

A. Solid: A solid possesses a definite mass, a definite size or volume, and a definite shape.

B. Liquid: A liquid possesses a definite mass and a definite size or volume, but has no definite shape. That is, a liquid alters its shape to correspond to that of its container.

C. Gas: A gas has definite mass only. A gas not only changes shape, like a liquid, but it does not remain, as liquids do, within any definite volume. It dissipates in all directions whenever it has a chance (1403).

III. TRANSFORMING ONE STATE OF MATTER INTO ANOTHER: Such transformations, as from solid to liquid, and from liquid to gas, are produced either by heat, chemical action, or radio-activity.

IV. MECHANICS—THE EFFECTS OF FORCE UPON MATTER: 2187.

A. Nature of Force: Force is "pull, push, pressure, tension, attraction, or repulsion." Therefore, to exert force, a body must meet resistance. In flying through an absolute vacuum, a bullet exerts no force whatever. In flying through air, it exerts force only in pushing aside the air. That is, force is exerted by a moving object *only in the quantity necessary to overcome resistance.* This is the meaning of Newton's Third Law of Motion (2190), that reaction is always equal and opposite to action.

a. Units of Force: The unit of Force in physics is the **dyne.** A dyne is a force sufficient to impart, in one second, a speed of one centimeter a second to a body weighing one gram. The dyne, therefore, is a unit in the metric or "centimeter-gram-second" (C. G. S.) system of units. The amount of force, which, acting on a pound, will produce at the end of a second, motion of one foot a second, is called a **poundal.** This is the unit of force in the "foot-pound-second" system of units. The symbol of force in physical formulae is **F**, and is understood to be Force expressed in dynes.

b. The Force of Gravity: Since in one second gravity imparts a speed of 980 centimeters a second to a gram of matter, the force of gravity is 980 dynes.

B. Quantity and Measurement of Force: Since force is called forth by reaction, the amount exerted may be measured by the reaction or "effect" produced. This is done by multiplying the mass of the body affected, by the **acceleration** produced. In symbols, it is expressed as $\mathbf{F} = \mathbf{m\,a}$, in which $\mathbf{a}$ is the symbol for acceleration, being defined below. This relation, expressed in Newton's Second Law of Motion (2190), may be called the foundation of mechanics.

C. Composition of Forces: When two or more forces act on a body at a given point and at the same time, the result is the same as if a single force, called the resultant, were applied. The process of finding the resultant of two or more component forces is called the "composition of forces."

a. Determination of Resultant: The resultant depends upon the angle between the component forces.

b. The Parallelogram of Forces: If a parallelogram be constructed in which the sides are drawn to scale, so as to represent the true proportions between two component forces, and if the angle between the sides be made equal to the angle between the component forces, then the diagonal which intersects that angle will represent, on the same scale, the resultant of the two forces. If there are three or more component forces, compound the first two and get the resultant, then compound this with the third force and so on until all have been compounded.

D. Resolution of Forces: Division of a known force into the component forces causing it is called "resolution of forces." It is performed by working the parallelogram of forces backward.

E. Kinds of Motion:

a. Translation: The change of position of the whole body in some direction. Example: An arrow in flight.

b. Rotation: The turning of a body about a stationary axis. Example: A fly-wheel.

c. Vibration or Undulation: To-and-fro motion of parts which does not change the position of the whole. Examples: a plucked banjo string, waves on the surface of water.

F. Qualities or Attributes of Motion:

a. Speed: Speed in physics means the speed of a moving body, *at any particular instant.* In order to define speed simply, assume an object traveling at a uniform speed. Measure the distance traveled in a given time, and divide this distance by the time. The answer is the speed. In symbols, $\mathbf{S} = \frac{\mathbf{x}}{\mathbf{t}}$. (S is the customary symbol for speed, and **t** for time; **x** has been used for distance traveled.)

b. Velocity: Velocity is speed *with reference to a given direction.* If, for example, we regard westward movement as positive, an eastward movement will have negative velocity. The symbol for velocity is **v.** Velocities may be "compounded" and "resolved" by the parallelogram method.

c. Acceleration: When a train starts, its velocity, or speed in a given direction, changes constantly. The rate of this *change* is called **Acceleration.** We determine acceleration by measuring the velocity at any given instant and again a few instants later. The difference is the acceleration over the period of time. The answer may be obtained by using the following formula: $\mathbf{a} = \frac{\mathbf{v}_2 - \mathbf{v}_1}{\mathbf{t}_2 - \mathbf{t}_1}$ ($\mathbf{v}_1$ and $\mathbf{t}_1$ are the velocity at the first observation and the time of taking it, while $\mathbf{v}_2$ and $\mathbf{t}_2$ are for the second observation.) The acceleration produced by Gravity (symbol **g**) at the surface of the earth is approximately 32.2 feet or 980 centimeters a second (1508).

G. **Attributes of a Body in Motion:**

  a. **Momentum:** The amount of force required to set a body of a given mass in motion at a particular speed, or what is the same thing, the amount of resistance required to stop the body when once it is moving at that speed. Both the mass of the body and its velocity determine its momentum. In symbols, momentum is usually expressed as **m v** (**mass times velocity**).

  b. **Kinetic Energy, or Striking Power:** The *striking power* of a moving object, as opposed to its *momentum* is $\frac{1}{2}mv^2$.

  c. **Centrifugal and Centripetal Force:** As stated in Newton's first law, a moving body will continue to move in the same straight line unless forced to do otherwise. In order then to swing a stone at the end of a string, we must apply force to keep the stone in a curved path. This force is supplied by the string. The resistance to curving offered by the stone is called *centrifugal force* (682) and the restraining force of the string is called *centripetal force*.

H. **Determination of Work, Power, and Energy:**

  a. **Nature and Measurement of Work:** In physics, **Work** upon a body is defined as the amount of motion, or the strain, compression, or distortion produced in it. No matter how great the force exerted, work is not done if the point of application does not move. Atlas holding the world on his shoulders was doing no work, according to the physical definition of work. The amount of work is the product of the force exerted by the distance traversed. In symbols, work is equal to **F X** where **F** is the force and **X** is the distance. The engineering unit of work is the **foot-pound,** the amount of work required to raise one avoirdupois pound a foot against gravity. The scientific unit is the work required to move a gram one centimeter against a resistance of one dyne. This unit is called an **erg**. Since it is so small, a **joule,** or 10,000,000 ergs, is often used.

  b. **Nature and Measurement of Power:** Under the definition of work given above, the work is the same if an object be moved a foot in a second or an hour. In ordinary life, however, the time element is important; and **Power** is force which does certain work *in a certain time*. In physics the unit of power is **an erg a second**—that is, the force which will move one gram one centimeter in one second against a resistance of one dyne. A larger unit is a joule a second, and is called a **watt.** This watt of mechanical power corresponds to the watt of electrical power (1116). The customary engineering unit is the **horse-power** (3349). The horsepower is equivalent to 746 watts.

  c. **Nature and Kinds of Energy (1148):** Energy is defined as the *capacity for doing work*. A hanging weight has capacity for doing work whenever it may be let fall. This "stored energy" is called **Potential Energy:** When falling, the weight has the capacity for doing work upon any object getting in its way. This energy is called **Kinetic Energy.**

  d. **Measurement of Energy:** The amount of *potential energy* stored by raising an object against gravity, is **m g h** (**mass** of the object, times **force of gravity** in dynes, times **height** to which the weight is raised).

I. **Properties of a Body at Rest—Statics: 2189.**

  a. **Balanced Forces:** Since gravity acts everywhere, every motionless body is constantly subject to two forces—the force of gravity and the corresponding resistance of the foundation upon which the body stands. The body is motionless because the resistance is equal to the downward pull. That is, the opposing forces are "balanced." A magnet holding up a piece of iron is another example of balanced forces. The science dealing with balanced forces is called **Statics.**

  b. **Center of Gravity:** So long as a body remains structurally rigid, all its weight may be considered as concentrated at one point, called the **Center of Gravity** (1509). The center of gravity always tends to get as low as possible. If therefore a body be suspended by an edge or corner, the center of gravity will be vertically below the point of suspension, this being the lowest attainable position.

  c. **Equilibrium:** The condition called Equilibrium—that is, lack of motion—exists in a body when the sum of all forces acting upon it in one direction equals the sum of those acting upon it in the opposite direction.

J. **Principles and Characteristics of Machines:**

  a. **Purpose of Machines:** In the broad sense a machine is (**1**) a device for transforming energy from one kind to another, such as a gasoline motor; (**2**) a device for transferring energy from one place or direction to another, such as the driving rod of a locomotive; (**3**) a device for changing the relative speed and strength of action of a force, such as a block, and tackle.

  b. **The Law of Machines and the Principle of Mechanical Advantage:** Since energy can neither be created nor destroyed, we can get out from a machine only the energy we put into it. In the simplest type of machine—the force "put in" is measured by its amount in dynes, times the distance over which it moves, and the work done is measured by the weight moved times the distance moved. Ignoring losses caused by friction within the machine, these two quantities must equal each other. This equality is the **law of machines,** which may be stated in symbols thus: $Fx = md$. (**F** is the force put in, **x** the distance over which it operates, **m** is the mass of the object moved, and **d** the distance over which it moves.) Although we can get out of a machine only the energy we put into it, we can make it move a small weight over a large distance, or a large weight over a small distance. The amount by which the weight-lifting power of a machine is multiplied, at a corresponding loss in distance lifted, is called its **mechanical advantage.**

  c. **Six Types of Machines in Physics:** The six types of machines known to mechanics are the **lever, wheel and axle, pulley, inclined plane, wedge,** and **screw.** Each type is explained in the article on

Mechanics (2187). All machines used in our industries, insofar as they involve the transformation of mechanical energy, are combinations of these simple types.

K. **Values and Disadvantages of Friction: 1370.** Allowance for friction loss must always be made when computing the power of machines from the energy applied.

V. EFFECTS OF FORCE UPON LIQUID MATTER—HYDRAULICS:

A. **Definition and Subject Matter of Hydraulics.** Hydraulics is the Science of Force in Liquids. Since gases at low velocities have many of the properties of fluids, those principles of Hydraulics which describe the behavior of pressure are also applicable to gases, not in rapid motion. Hydraulics is divided into two branches, depending upon whether the liquid considered is at rest or in motion, as follows: (**1**) **Hydrostatics,** or the science of liquids at rest; (**2**) **Hydrodynamics,** or the science of liquids in motion. Since the problems of hydrodynamics—problems such as the design of water turbines, the theory of vortices in flowing streams and so on—require the use of higher mathematics in their solution, the discussion in this Outline will be confined to Hydrostatics.

B. **Pressure and Flow:** Aside from gravity, the great force causing phenomena within liquids is **Pressure.** Pressure arises from: (**1**) Atmospheric pressure upon the surface of the liquid; (**2**) The weight of overlying liquid; and (**3**) Cohesion, or the tendency of molecules to adhere, within the liquid. The usual symbol of pressure is **P.** In this connection it is well to remember that all liquids are virtually "incompressible," that is, they cannot be forced at a given temperature into a smaller space than they normally occupy.

a. **Qualities and Attributes of Pressure:**

1. **Pressure Due to Atmosphere:** This is computed by multiplying the total area of the surface by the atmospheric pressure. This pressure is the same throughout the liquid.
2. **Pressure Due to Gravity:** Since weight is merely downward pressure caused by gravity, the gravitational pressure at any level is the weight of the vertical column of liquid above that level. Since liquids tend to move sidewise as well as downward, this pressure acts equally both downwards and sidewise at any given level against the walls of the container. Pressure against a side is always exerted at right angles to the side, no matter what the slope of the side may be.
3. **Uniformity of Pressure throughout a Liquid:** If the pressure upon a confined liquid be increased by a certain amount at any point, the liquid will transmit that same increase of pressure equally throughout its whole extent. It is this principle which makes possible the Hydraulic Press (1710, 1709 picture). The name "hydrostatic paradox" is applied to the fact that such devices as the hydraulic press appear to "create" energy. Such is, of course, not the case, since the distance moved by the larger piston decreases in direct proportion to the increased force it exerts.
4. **Uniformity of Levels in Connecting Vessels:** The uniformity of pressure within liquids explains why a liquid remains at the same level in connected open vessels no matter what their relative size.
5. **Principle of the Siphon: 3243.**

b. **Phenomena of Immersion:**

1. **Principle of Archimedes:** This principle (174, 1509) states that **a body immersed in a fluid is buoyed up by a force equal to the weight of the fluid it displaces.**
2. **Why Some Bodies Sink and Others Float:** A liquid buoys the body up; the body's weight forces it down. If its weight is greater than the weight of the water it displaces, the downward force will be the greater and it will sink. But if the body's weight is, for instance, only half that of an equal volume of water, it ceases to sink when half of its volume is immersed, the upward thrust of the displaced water then being equal to the downward thrust of its weight. This principle is utilized in the Hydrometer (1711).

c. **Cohesion and Capillarity:** The molecules of a liquid "stick together" with appreciable force. This "clinging tendency" is called **Cohesion,** and creates a force called **Surface Tension** on liquid surfaces Surface tension causes the phenomena of **Capillarity** (641).

1. **Surface Tension:** Within a liquid, every particle is drawn in all directions by the cohesiveness of its neighbors. At the surface, however, only those particles *below* and at the sides exercise attraction. The result is a definite *pull* toward the center of the liquid. If gravity did not interfere, this pull would bring each portion of the surface to an equal distance from the center, thus drawing the liquid into a sphere. This actually happens in the case of raindrops, where every particle is already responding fully to gravity—and surface tension has a free hand in forming the water into droplets. Soap bubbles (3267) are still another example.
2. **Curvature of Surface:** Surface tension causes the curved portion or **meniscus** which adjoins any solid surface rising from a liquid. Menisci are of two kinds: (**1**) when the liquid wets the solid—that is, when particles of the liquid will adhere to the solid—a portion of the liquid always gets above the general surface level, then attracts nearby particles of liquid toward it. The process continues until the downward pull of gravity upon the raised liquid equals the upward pull of the elevated particles. The resulting meniscus will be concave; (**2**) when the liquid does not wet the solid—as when glass dips into mercury—a convex meniscus is formed, for then the liquid obeys as far as possible the tendency mentioned above of forming itself into a sphere.
3. **Capillarity in Small Tubes:** If the diameter of an upright tube standing in a liquid be small enough so that menisci on each side join or nearly join in the middle, their pull is sufficient to raise or depress the general level of the liquid in the tube from that of the surrounding liquid.

If the liquid wets the tube, capillarity will draw it upward; if it does not wet the tube, capillarity will force it downward.

VI. EFFECTS OF FORCE UPON GASEOUS MATTER—PNEUMATICS:

- **A. Relation of Pneumatics to Hydraulics:** Hydraulic principles relating to fluid pressure apply also to gases not in motion. They need not, therefore, be restated here as applied to gases. Typical laws are those of pressure upon containers and Archimedes' principle. Since gases are compressible, principles involving the incompressibility of liquids, such as the hydrostatic paradox, are not applicable.
- **B. Nature of Gaseous Pressure:** The general nature of gaseous pressure is explained on page 1403.
- **C. Relations of Temperature, Pressure, and Volume:** As may be understood from considering the molecular nature of gases (1403) and the molecular nature of heat (1618), the temperature, pressure, and volume of a gas are intimately dependent upon each other, as follows:
    - **a. Boyle's Law: 1403.** This law states that, at a given temperature, the volume of a gas decreases in proportion as pressure increases. This law may be stated as a proportion: $\frac{P_1}{P_2}=\frac{V_2}{V_1}$, in which P_1 is the initial pressure and P_2 is the added pressure; V_1 is the initial volume and V_2 is the volume due to the added pressure.
    - **b. Charles's Law:** This law asserts that, if the same pressure is maintained, the volume of a gas increases regularly with increase in temperature. The amount of increase is called the coefficient of expansion, and is, for all gases, almost exactly $^{1}/_{273}$, or 0.003662 of the volume for each degree of temperature on the Centigrade Scale.
- **D. Avogadro's Rule:** Avogadro's Rule states that equal volumes of gases at equal temperatures and pressures contain an equal number of molecules, whatever the gases may be. The rule is of immense importance in chemistry in determining atomic weights. Although Avogadro deduced it from the results of chemical experiments, the rule may be proved by calculating the behavior and properties of the molecules within a gas, by means of higher mathematics.
- **E. Atmospheric Pressure and the Barometer:** These subjects are discussed in the articles on Air (50–3) and Barometer (332).

HEAT AND ITS PRINCIPLES

I. NATURE OF HEAT: According to modern theory, heat is *motion* of the molecules within a substance (1618), and the amount of heat present is determined by the total amount of motion present. When there is no motion, there is no heat—that is the body is at **absolute zero** (1618) in temperature. The theory that heat is a consequence of molecular motion is called the **kinetic theory of heat.**

II. BASIC LAWS OF HEAT:

- **A. Principle of the Conservation of Energy:** 1148, 1618.
- **B. Principle of the Dissipation of Useful Energy (Carnot's Principle):** Common sense tells us that heat cannot of itself pass from a colder to a hotter body. This fact, seemingly trivial, is really tremendously important. It means, for instance, that if we want to heat a body, we cannot do so by transferring a portion of their heat from colder bodies and so "build up" heat. We must do so by abstracting heat from a still hotter body, or by using chemical energy such as we have in unburned coal, or potential mechanical energy such as we have in a raised hammer. All the theories and causes of Physics must agree with this principle, that heat always "runs down."

III. ATTRIBUTES OF HEAT: Since heat is molecular motion, the amount present in a body depends upon two factors: **(1)** the average *speed* of the moving molecules, and **(2)** the *number* of moving molecules. If we keep this in mind, the phenomena of heat will be much more easily understood.

- **A. Temperature:** Temperature is the "relative hotness" of any body, as compared with any convenient standard, the most convenient being the comparison of the expansion produced in some substance by the temperature in question with the known expansion produced by some standard temperature. Instruments for doing this are Thermometers (3486) and Pyrometers (2941). The "absolute scale" of temperatures based upon "absolute zero" or complete lack of the molecular motion which produces heat is often used in science (1618).
- **B. Specific Heat:** It takes more energy to raise the average speed of the molecules—that is to raise the temperature—in substances where they are bound tightly by physical or chemical forces, than it does in others. The amount required to raise a given substance's temperature one degree, as compared with the amount required for the same mass of water, is called the **Specific Heat** (1620) of the substance. Water is used as standard with a value of 1 because its specific heat—that is the amount of energy required to raise it one degree in temperature—is the greatest known. Specific heats of other substances are therefore always less than one.
- **C. Latent Heat:** A parallel to specific heat is **Latent Heat,** or the heat required to change the physical state of a substance (3696), as in changing ice to water. While a body is absorbing latent heat, its temperature remains unaltered. When the change is reversed, as in changing water to ice, the latent heat is *given out* by the changing substance.
- **D. Measurement of Heat:** Since the quantity of heat, or amount of molecular motion in a substance, depends upon **(1)** its temperature, **(2)** its mass, and **(3)** its specific heat, the unit of heat quantity must contain these quantities. The commonest units are the **lesser calorie** (1620), employed in scientific computations, the **greater calorie** (1320) employed in computing food values, and the **British Thermal Unit** (1620) employed in engineering.

IV. **EFFECTS OF HEAT ON MATTER:**

A. **Expansion and Contraction:** Since heating a body gets its molecules to moving faster, they push each other farther apart, and the substance as a whole expands somewhat. The amount of expansion produced by a given amount of heat, as compared with the original bulk of the substance, is called its coefficient of expansion.

a. **In Solids:** Practically all solids expand at a uniform rate as heat is applied, up to the point where they become liquid. The alloy invar (2507) is valuable because of its remarkably low coefficient of expansion.

b. **In Liquids:** All natural liquids except water expand uniformly, the amount depending upon the kind of liquid. This behavior of water is explained on page 1618 (picture) and on pages 3693–4.

c. **In Gases:** Practically all gases, irrespective of their chemical nature, have the same coefficients of expansion, as explained under Pneumatics, "Boyle's Law."

B. **Change of Physical State:** When sufficient heat is applied, matter changes state. That is, because their particles are speeded up, solids become liquids and liquids become gases. Loss of heat reverses the process. Details are given in the articles on Freezing (1361) and Evaporation (1207).

a. **Change from Solid to Liquid:** Melting points, or the temperatures at which the change from solid to liquid takes place, are given for common substances on page 1362. Obviously, melting points are also the "freezing points" at which cooling liquids become solids (1361).

b. **Change from Liquid to Gas:** This change is accomplished by: **(1)** Evaporation, **(2)** Boiling or Ebullition, and **(3)** Explosion. In **Evaporation** (1207), minute particles of liquid shoot off from the surface into surrounding space, thus transforming the liquid gradually into vapor. **Boiling** is a form of evaporation so violent that it takes place not only on the surface but within the liquid, giving rise to bubbles of vapor (see Distillation, 1014). **Explosion** is a change so violent that the liquid "bursts," so to speak, into gas all at once. The reverse process, by which gas is transformed into liquid, is called **Condensation,** discussed under Dew (1000).

c. **Change from Solid to Gas:** This process with the intermediate liquid stage omitted, is comparatively rare. It is seen however in the case of explosions (1211). The reverse process is an extremely rapid condensation.

C. **Transmission of Heat:** Heat is transferred by Conduction, Convection, and Radiation, as explained on page 1619.

D. **Machines for Transforming Heat into Work:** Familiar devices for doing this are Steam Engines (3348) and Gas Engines (1403).

SOUND AND ITS PRINCIPLES

I. **NATURE OF SOUND: 3276, 2786.** Sound is carried by longitudinal or "compression" waves (3706) in elastic matter. Although the most usual medium is air, any solid or liquid can transmit sound, provided it is elastic and therefore capable of vibration (3276).

II. **VELOCITY OF SOUND:**

A. **General Law of Velocity:** In any medium the velocity varies directly as the square root of the elasticity and inversely as the square root of the density of the medium.

B. **Some Figures for Sound Velocity:** Hydrogen, one sixteenth as dense as oxygen, carries sound four times as fast as oxygen (4190 feet a second in hydrogen at 0° C.). Liquids, though denser than gases, are still more elastic, and therefore convey sound more rapidly (4,730 feet per second is the rate in water). Elastic solids are best of all (nearly 11,000 feet a second is the rate in pine wood, more than 12,000 feet a second in copper, and more than 15,000 feet a second in iron). All these speeds are at a temperature of 0° C.

III. **REFLECTION OF SOUND: 3278.**

A. **Echo: 1073.**

B. **Whispering Galleries: 3278.**

IV. **REFRACTION OF SOUND:** Sound is bent or **refracted** whenever it passes obliquely from one medium into another, in which its velocity is different. The direction of refraction may be determined as follows: If a perpendicular to the surface separating the media be assumed, the sound wave will bend away from the perpendicular if passing into a medium where its velocity is greater, and toward the perpendicular if its velocity is retarded.

V. **DISTINCTION BETWEEN TONES AND NOISES:** If the pulses of a sound wave are regular, they produce an effect upon the ear (1057) which we call a "tone." If the wave is "all jumbled up," it causes a "noise" (3278).

VI. **PROPERTIES OF TONES:**

A. **Pitch:** By Pitch is meant the relative "highness" or "lowness" of a sound. The pitch of a note depends upon the **rate of vibration** (3278).

B. **Intensity:** Intensity or "loudness," depends upon three factors: **(1)** The power of the original pulse (3277), **(2)** the distance from the source of sound (3277); and **(3)** the density of the transmitting medium. A pistol shot produces a feeble sound in the rarefied air of a high mountain top.

C. **Tone-Quality or Timbre:** That quality which distinguishes a note played on a violin from the same note played on a flute is called "tone-color" or "timbre." The different qualities of the instruments are given by **overtones** (3278).

D. **Effect of Motion on Pitch:** When the source of sound is approaching rapidly, the pitch rises; when the source recedes, the pitch falls. This is known as Doppler's Principle (3277).

VII. PRODUCTION OF TONES:

A. **In Strings:**

a. **Effect of Length:** Tension and diameter being constant, the vibration rate (which determines pitch) varies inversely as the length.

b. **Effect of Tension:** Length and diameter being constant, the vibration rate varies inversely as the square root of the tension.

c. **Effect of Mass:** Length and tension being constant, the vibration rate varies inversely as the square root of the mass of a unit length. Mass is determined by the material and the diameter of the string.

d. **Tuning:** Since in any stringed instrument the length, material, and size of each string is fixed, tuning is accomplished by varying the tension.

B. **In Enclosed Columns of Air:** In wind instruments (2383) the pipe or tube acts as a resonator for vibrations produced in the air blown into them.

a. **Effect of Length:** Vibration rate and therefore pitch vary inversely as the length of the vibrating air column. Thus, doubling the length gives a tone an octave lower. Manipulation of "stops" on the enclosing pipe enables the player to vary the length of the vibrating column, and therefore the pitch of the note emitted.

b. **Open and Stopped Pipes:** An open pipe gives a tone an octave higher than a stopped pipe of the same length.

c. **Voice: 3656.** The human vocal organs are a type of reed instrument in which the vocal cords are the reeds.

VIII. PHENOMENA OF COMBINED TONES:

A. **Forced Vibrations:** When a strongly vibrating agent is pressed against another, the second is forced to vibrate in agreement with the agent pressed against it, regardless of what its natural vibration rate might be. Such a vibration is a **forced vibration.** Stringed instruments use forced vibrations of sounding bodies to amplify the sound produced by the strings themselves. The sounding board of the piano, and the wooden shells of the guitar, violin, mandolin, and ukulele, are examples.

B. **Sympathetic Vibrations:** Forced vibrations are produced by strong external force. A slight force, however, is quite enough to set a vibrating agent going **in its own period.** Even slight air pulses, carrying a tone of the proper vibration rate, or even a strong overtone, are enough. Vibrations caused thus are called **sympathetic vibrations.**

C. **Resonance:** When one vibrating body sets another in sympathetic motion, the second emits pulses which in turn help the first. Such a "building up" is called resonance. The so-called "sound of the sea" in a shell held to the ear, is a case of resonance reinforcing whatever faint sound is in tune with the period of the air enclosed in the shell. Complex tones may be resolved into fundamental and overtones, by using "Helmholtz resonators" or artificial shells of different known periods. Each "shell" reinforces the overtone with which it is in unison, and thus enables all overtones to be picked out.

D. **Interference:** Two waves with the same characteristics travelling in opposite directions, "cancel" each other when they meet. Such a "cancellation" is called interference. "Soundless zones" have been produced accidentally where reflected sound from a fog signal meets and interferes with the sound direct from the signal.

E. **Beats:** If two adjoining instruments are sounding nearly but not quite the same note, we get alternate resonance and interference. At first the two pulses reinforce each other and we have resonance; then the vibrations of the lower-pitched instrument lag until they are half a vibration behind, whereupon the vibrations oppose each other and we have interference. When the "lag" amounts to a full vibration, we have resonance again—and so on. This alternate resonance and interference produces a pulsing quality which musicians call "beats," in the combined tones.

F. **Musical Intervals and Scales:** For some psychological reason, tones whose vibration rates bear simple ratios to each other are pleasing to us when played in various combinations.

a. **Musical Intervals:** The simpler musical combinations of tones are called Octaves, Thirds, Fifths, etc. When a note has twice the vibration rate of another, it is said to be an **octave** above the other. For example (C to the next higher C). When the rates are in the ratio of 2 to 3, the interval is a **fifth** (C to the next higher G). A ratio of 3 to 4 gives a **fourth** (G to C above); one of 4 to 5, a **major third** (C to E); one of 5 to 6, a **minor third** (E to G); and one of 24:25, a **chromatic semitone.** A combination of tones harmonically related and sounded together forms a **chord.**

b. **The Diatonic Scale or Gamut:** If between the two notes of an octave we insert a series of notes with simple intermediate vibration ratios, we have a pleasing succession of tones known as a **scale.** In the so-called **diatonic scale,** the notes, beginning with C for the lower end of the octave, are as follows, the vibration ratio of each note to the one next above it being given in parentheses: **C** (vibration ratio with D, 8 to 9); **D** (ratio with E, 9 to 10); **E** (ratio with F, 15 to 16); **F** (ratio with G, 8 to 9); **G** (ratio with A, 9 to 10); **A** (ratio with B, 8 to 9); **B** (ratio with upper C, 15 to 16). Each of these intervals has one of three values: 8 to 9, called a **major tone;** 9 to 10, a **minor tone;** 15 to 16, a **major semitone.** The note upon which the scale begins is called the **fundamental** of the scale, and the other notes are the second, third, etc., up to the eighth, or octave. A **sharp** is a note raised by a chromatic semitone and a **flat** is a note lowered by a chromatic semitone. Chromatic semitones may be inserted between all tones of the scale except in the two "major semitone" intervals (from the third to the fourth, and from the seventh to the octave).

c. The Tempered Scale: Each note may be made the keynote of a scale with intervals having the same ratios as those of any other scale. If the intervals are kept precisely true to these ratios, however, the tones of the various scales do not exactly coincide in their rates of vibration. Comparing the scales of C and G, for example, we find that the notes A and F have a slightly higher vibration rate in the scale of G than in the scale of C. If a piano were to be built to sound the true notes in all scales it would need to have about 50 notes in each octave. Since this is manifestly impossible, a system of compromise has been adopted. The octave is divided into 12 approximately equal intervals, all of which (except the octave) differ slightly from the true diatonic intervals. This is called the **equal temperament scale.** By accepting the slight irregularities thus produced we can make the same piano do for any key.

d. Vibrations of Rods, Plates, Bells, and Membranes: The laws governing such bodies usually are exceedingly complex. Their study is aided in many cases by scattering sand over the surface of a vibrating plate. Under the influence of vibration the sand rearranges itself in various designs (3277 picture).

PHENOMENA AND PROPERTIES OF ETHER

I. GENERAL NATURE OF ETHER: The general nature of **Ether** as a weightless, elastic, and intangible substance is described on page 1180.

II. HISTORY OF THE ETHER THEORY: The idea of such a substance as Ether was first propounded by Huygens in 1690 in order to explain light (1998) and was accepted when Young and Fresnel, in the first 20 years of the 19th century, overthrew Newton's "corpuscular theory" of light. Clerk-Maxwell changed the theory somewhat, but identified light with certain phases of electricity (1122). None of these men devised any direct proof that ether exists, other than to show that such a medium was the best explanation of the phenomena.

LIGHT AND ITS PRINCIPLES

I. NATURE AND PROPAGATION OF LIGHT:

A. Light as a Form of Wave Motion in Ether: 1998, 1180, 3706, 3276.

B. Cause of Light Waves: The waves which transmit light apparently are caused in some unknown manner by vibrating molecules of matter. Usually the necessary vibration is set up in matter by heat (1998); but it occurs in some forms of organic matter without heat, and such light is known as *phosphorescence* (2776, 2000).

a. Luminous and Non-Luminous Bodies: Luminous bodies are those like the sun, which have sufficient energy in their natural state to emit light. Other bodies are naturally non-luminous, and are distinguished, with reference to their behavior toward light, by one of the following three properties:

1. **Transparency:** Substances like clear air, water in thin layers, and glass, let the light pass through so freely that we can see objects in them on the other side of them. Such bodies are **transparent.**
2. **Translucency:** Substances like horn, colored and ground glass, fine porcelain, and paper, transmit light, but not clearly enough to permit objects on the other side of them to be seen distinctly. Such bodies are **translucent.**
3. **Opacity:** Substances like wood, stone, and cold metal block the passage of light. Such bodies are **opaque.**

C. Velocity: The speed of light and its measurements are described on page 1997.

D. The Path of Light: In all ordinary light phenomena, such as casting shadows, behavior in lenses, etc., light seems to travel outward from its source in straight lines, like the ribs of a fan. It was this fact that led Newton to accept the corpuscular theory (1998). This "straight-line" propagation is really due to the exceedingly small size of light waves. Although light is carried by waves, and not by "straight-line" rays, as Newton imagined, the "ray" idea is very useful in many explanations. Whenever we use it, we mean a line **perpendicular to the wave front at the point considered**—that is, a radius prolonged. When we say that a "ray" is bent, we really mean that the geometric center of the wave-front has shifted.

E. Intensity of Light: The intensity of light at the origin depends upon the energy of the disturbance creating it. This disturbance spreads out in all directions, so at any given distance the energy may be regarded as distributed around the circumference of a circle whose radius is the distance. In order to compare intensity at different distances, we must therefore compare these circumferences. Since circumferences are to each other as the squares of their radii, we get the rule: **The intensity of illumination from a given source varies as the square of the distance from the source.**

—**Standard Unit of Illumination, or Candlepower:** The illuminating power of a candle made of spermaceti weighing one-sixth of a pound and burning 120 grains of its substance an hour is the standard source of light used in computing illumination in the United States. The work of measuring comparative illumination is called **Photometry.**

II. REFLECTION OF LIGHT: 2000.

A. Cause of Reflection: Since light travels outward in waves from its own source, the front of each wave is circular. When such a wave strikes a plane surface, the middle portion hits first and starts back, while the "wings" are still "coming on." Then they hit and start back; but their late arrival has caused the wave to be "reversed." That is, instead of being convex toward the reflecting surface, the wave is now concave.

B. Laws of Reflection: The manner in which light is reflected is described by the following two laws:

a. The Angles of Incidence and Reflection are Equal: 2000.

b. The Incident and the Reflected Rays Lie in One Plane Perpendicular to the Reflecting Surface.

III. REFRACTION OF LIGHT: 1987.

A. Cause of Refraction and Refractive Index: In water, glass, and other "optically dense" substances, light moves at a velocity less than air. Therefore a light wave entering water or glass **obliquely** from air, is slowed up at the side which first enters the denser medium, and this "drag" changes the direction of the wave. The **Law of Refraction** is discussed on page 1987. The amount of refraction produced at the boundary surface of two media is called the **refractive index** for the media in question.

B. Refraction, Partial Reflection, and Total Reflection: In any case of refraction, only a part of the light passes from one medium into another and is refracted; the rest is reflected from the boundary surface. The portion reflected increases as the angle becomes more oblique, and at a certain value, called the **critical angle,** the refracted ray lies along the boundary surface. At angles still more oblique, all the light is reflected.

C. Lenses and Prisms: 1986, 3311-14, 2779, 3462-3.

D. Spherical Aberration: 3462.

E. The Eye as an Example of Lens Action: 1213.

IV. DIFFRACTION OF LIGHT AND INTERFERENCE: Interference is the phenomenon whose discovery, announced in 1802, overthrew the ray or corpuscular theory of light, and set up the wave theory in its place. Light waves, in passing through narrow openings or across the sharp edges of objects, are radiated out from the points of contact in paths which intersect the waves which have not been so disturbed. This is known as **diffraction.** The diffracted waves alternately reinforce and counteract the undisturbed waves in such a way as to produce bands or zones of light and dark. This phenomenon is called **interference.** Interference effects, however, are so small that they can be detected only by special apparatus. A diffraction grating (3314) is one; the interferometer (1998) is another.

V. PHENOMENA OF COLOR: The general nature of color and its perception in objects are given on page 837. The cause is explained on page 1998.

A. Refraction of Color: The amount of refraction (see "Refraction" above) caused in light depends upon its wave-length. Since difference in color is due to difference in wave-length, it follows that in a given refracting device, **each color will be refracted by a different amount.** This behavior is the cause of **Rainbows** (2972), and is taken advantage of in such instruments as the **Spectroscope** (3311). Longer waves refract less than shorter. Since red has the longest wave, it refracts the least (3312, 3311).

B. Chromatic Aberration: Since different colors refract differently, it follows that a convex lens focusses each color at a different point, the violet being focussed nearest the lens, and the red farthest away. This behavior is known as **chromatic aberration** (3462) and is corrected by using compound or "achromatic" lenses (3462, 1987-8).

VI. POLARIZED LIGHT: The behavior of Polarized Light, and some of its uses, are explained on page 2000.

VII. X-RAYS AND RADIO: According to present theory, these phenomena differ from light chiefly in the wave-length which carries them through the Ether (3312). The apparatus used and the peculiarities of each phenomenon are described in the articles on X-rays (3824) and Wireless Telegraphy and Telephony (3758).

ELECTRICITY AND MAGNETISM

I. NATURE OF ELECTRICITY: 1108. The actual nature of electricity is unknown. Physics now assumes electricity to be caused by two kinds of minute particles called **electrons** (256, 1112, 1111 picture, 1125). The **positive electron** is comparatively large and inert, and bears a charge of so-called "positive electricity," which is merely a name for an attractive power of unknown nature. The **negative electron** is comparatively light and active, and bears a charge of "negative electricity." These charges are of such nature that "like repels like, and attracts unlike." This basic theory explains all known phenomena of electricity, both "static" and "current."

II. PROPERTIES OF ELECTRIC CHARGES:

A. Creation: Electric charges or "static electricity" is created by friction (1108, 1111 picture, 1108). It is impossible to create one kind of charge without bringing into existence somewhere, an equal charge of the opposite kind. For some unknown reason, free electrons travel readily in certain classes of substances, particularly the metals. These substances are called **conductors.** It is difficult to create charges by rubbing two conductors together, because the charges leak away. Frictional charges are best created upon non-conducting substances, known as **dielectrics** (1110).

B. Attraction, Repulsion, and Polarity: The mutual behavior of electric charges is summed up in the simple rule, "like attracts unlike, and repels like" (1110, 1112 picture). The sign of a charge is its **polarity.**

C. Induction across Space: The free electrons in a charge upset the balance between the positive and negative electrons in near-by bodies. If a positive charge be placed near the end of an insulated rod, it will attract negative electrons to the nearer end of the rod, leaving a mass of "unneutralized" or free positive electrons at the other end. When the inducing charge is removed, these effects disappear.

D. Potential: The "potential" of an electric charge is simply the pressure, or attractive power, tending to pull separated electrons (or "charges") of opposite signs together (1110). When two charged bodies each have a potential of the same sign, the body of greater potential will drive part of its charge to the other, until the two are equalized. The "driving pressure" or **electromotive force (E.M.F.)** moving the charge is the potential difference (P.D.) between the areas. If the potentials are of opposite sign, the E.M.F. is the sum of the potentials. The strength of a charge may be measured by an electroscope (1110).

F. **Electrostatic Capacity:** A considerable number of free electrons may be accommodated between the molecules of some substances, without any great upset in the "potential" of the substance. In other substances, the addition of a few electrons produces a marked change in potential. This relation between the amount of charge—that is the quantity of electrons absorbed—and the resulting change in potential is called the **capacity** of the substance.

G. **Condensers:** If a body, such as a metal plate, be charged and another plate which is connected to the earth be brought near it, the capacity of the first plate for holding electricity is increased. Such a device, which may consist of many plates separated by insulators, is called a **condenser** and is used in many practical ways, where it is desired to accumulate large electric charges.

  a. **Effect of Intervening Insulator or Dielectric:** Experiments show that the "ether strain" caused by the presence of the charges takes place in the surfaces of the intervening insulator or **dielectric.** When the strain becomes more than the dielectric can bear, it ruptures, a spark passes, and the charges unite. The capacity of a condenser therefore depends in part upon the ability of the dielectric to withstand electric stress.

  b. **Leyden Jars:** The oldest known form of condenser is the Leyden jar (1118).

III. PROPERTIES OF MOVING CHARGES—ELECTRIC CURRENTS:

A. **Nature:** An electric current is simply a rush of negative electrons through a conductor. Such a rush is set up by discharging a condenser, but is over almost instantly. In order to have a steady current, we must have some means for creating charge, or potential difference, as rapidly as the rushing electrons carry the charge away. Such a current is often called **galvanic** or **voltaic** (1120).

B. **Creation of Currents by Chemical Means:** The first and simplest means of creating a galvanic current is by the chemical energy of a so-called **voltaic cell** (1120, 1109 picture, 1112–13). The two metals zinc and copper are called **electrodes,** and the sulphuric acid is the **electrolyte.**

  a. **Polarization:** In the simple voltaic cell, the chemical action gradually accumulates hydrogen upon the copper plate. When a certain amount has accumulated, it blocks further action, and current output ceases. This blocking is known as polarization, and must be avoided by cleaning away the hydrogen, or using chemicals which do not produce it.

  b. **Types of Cells:** A single chemical unit is called a **cell.** A group of units is a **battery.** Common types of chemical units follow: **(1) The Daniell Cell:** A zinc plate is immersed in a zinc sulphate solution contained in a porous earthen cup. The cup and a copper plate are then immersed in a solution of copper sulphate. Negative electrons then flow from the zinc, as in the voltaic cell. **(2) The Gravity Cell:** In the gravity cell, the reactions occur as in the Daniell cell, but the two solutions are kept separate by gravity instead of a porous cup. The copper sulphate and the copper plate are placed in the bottom of the cell and the lighter zinc sulphate solution floats above, surrounding the suspended zinc plate. **(3) Leclanché and Dry Cells:** A zinc rod supplies negative electrons with carbon as the positive electrode and an electrolyte of dissolved sal-ammoniac. The Leclanché is the so-called "common wet cell," while in the common "dry cell" a moist packing is substituted for the watery solution. **(4) Storage or Secondary Batteries (3361).**

C. **Creation of Currents by Heat:** Heat can be made to produce current by means of the thermocouple (1113).

D. **Creation of Currents by Mechanical Means:** This method, used in Dynamos and Generators, depends upon electro-magnetic induction. It will be discussed under that heading.

IV. LAWS AND SIMPLE PHENOMENA OF "DIRECT" ELECTRIC CURRENTS:

A. **Direct and Alternating Currents Distinguished:** A current may flow steadily in one direction, as it does from a voltaic cell, or it may reverse direction periodically, as in the case of a condenser discharge. The first type is a **direct current (D.C.)** and the second is an **alternating current (A.C.)** Since alternating currents are created by electromagnetic induction, we shall discuss direct currents only at this point.

B. **Attributes of a Direct Current: 1116, 1110.** The characteristics of a direct current are determined by the following elements: the **quantity** of electrons moving, or volume of current (symbol **I**), measured in **amperes;** the **pressure** which drives the current (symbol **E**), measured in **volts;** and the **resistance** which the current encounters (symbol **R**,) measured in **ohms.** The pressure is the same as the "potential difference" between the terminals of the generating unit supplying the current. It is usually called the **electromotive force (E.M.F.).** The power of the current depends upon both the quantity of current and the pressure under which it flows, and is measured in **watts** (1116). The various units are so chosen that the watt of electrical power will be the same as the watt of mechanical power. A **coulomb** is the quantity of electricity delivered in one second by a current of one ampere.

B. **Ohm's Law:** The relation between potential, current, and resistance is expressed by Ohm's Law (1120). In symbols it is as follows: $\mathbf{I}=\frac{\mathbf{E}}{\mathbf{R}}$, in which **I** is expressed in amperes, **E** in volts, and **R** in ohms.

C. **Divided Currents:** Series and Parallel Connections. When current passes through one element after another in a circuit—as when it passes through a bank of lamps, or a series of dry cells—the elements are said to be connected in **series.** When branches divide the circuit and send a part of the current through each element, the elements are connected in **parallel.**

- **D. Measurement of Current:** Electric currents are measured by means of instruments called Galvanometers (1392, 1113). Those which measure amperes are called Ammeters, and those which measure volts are called Voltmeters.

V. NATURE OF MAGNETISM: The Molecular Theory of Magnetism (2122) explains the properties of magnets as being due to the symmetric arrangement of molecules within the magnetic body. But we do not yet know what makes the molecule of certain substances magnetic.

- **A. Polarity:** The "north-and-south pole" phenomenon in magnets is explained on page 2122, and in the article on the Compass (853). The Compass article also explains the difference between magnetic variation and deviation.
- **B. Magnetic Dip:** A Magnetic needle so mounted as to move freely in all directions will be found, if observed anywhere but on the magnetic equator or "aclinic" line, to dip at one end. The angle which it makes with a horizontal plane is called the **inclination** of the needle or **magnetic dip.** At the magnetic pole the dip is 90 degrees. That is, the needle stands straight on end.
- **C. Magnetic Substances and Magnetic Penetration:** Substances which can be attracted or magnetized are called magnetic. The only important ones besides iron and steel are nickel and cobalt. Magnetic force acts freely through all non-magnetic substances, but is "screened" by sheets of magnetic substances.
- **D. Lines and Fields of Magnetic Force:** Magnetic force seems to act along lines called **lines of force,** flowing out from the north pole and into the south pole. These lines can be traced by placing a glass plate over a magnet and dusting iron filings upon it (2123 picture). The filings will arrange themselves along the "lines." Since magnetism seems to act thus along definite lines, physicists always use these lines as a means of picturing magnetic conditions in an area. A **magnetic field** is therefore the complete group of lines depicting magnetic conditions in a given area.

VI. ELECTROMAGNETIC INDUCTION: The fact that electricity and magnetism are related phenomena was discovered when Oersted found that an electric current had magnetic effects (1121), and Faraday found that a magnetic field generated electric currents (1224, 1050, 1051 picture).

- **A. Magnetic Field of a Current:** When direct current passes through a straight wire, a magnetic field is created. In any plane cutting squarely across the wire the lines of force are formed as concentric circles with the wire as a center.
  - **a. Determining Direction of the Lines of Force:** Grasp the wire with the right hand, with the thumb pointing in the direction the current flows. The fingers will then point in the direction in which the force along the magnetic lines is exerted.
  - **b. Magnetic Field Around a Coil:** If a wire carrying a current is bent into a loop, all the lines of force enter the loop at one face and come out at the other face. If several loops are put together to form a coil, practically all the lines of force will pass around the outside and through the center of the coil, as if it were a single wire. Such an arrangement is known as a solenoid. If an iron core be placed within the loops of the coil, the power is greatly increased, and the device is known as an electromagnet (2122).
    1. The strength of an electromagnet depends upon the strength of the current and the number of loops or turns of wire which form the coil.
    2. To determine the polarity of an electromagnet, grasp the coil with the right hand, so that the fingers point in the direction of the current in the coil. The thumb will then point to the north pole of the coil.
- **B. Induction of Current by a Magnetic Field:** Faraday found that when lines of magnetic force move across a conductor, or when a conductor moves across lines of magnetic force, a current is set up or induced in the conductor. It is this discovery which makes it possible to turn mechanical energy directly into electrical energy by such devices as the dynamo (1050).
- **C. Character of Induced Currents:** Current is induced under the circumstances described above only when the conductor is **moving** in the magnetic field, and the strength of the induced E.M.F. varies directly as the speed of the moving conductor. Of course, if it is the magnetic field which moves and the conductor which remains stationary, the effect is the same. If the conductor be a coil of many turns of wire and if the magnetic field be created by an electromagnet, the current is naturally much stronger.
  - **a. Direction of Induced Currents:** Any induced current has such a direction that the magnetic action it sets up after it starts tends to resist or oppose the motion which produces it.
  - **b. Three-Finger Rule:** In order to discover readily the direction of an induced current in a wire, point the index finger of the right hand straight ahead, the thumb to the left, and the middle finger down; now set the index finger in the direction in which the lines of magnetic force are acting, and thumb in the direction in which the wire is moving with respect to the lines of force; the middle finger will then point in the direction of the induced current.
- **D. Currents Induced by Other Currents:** We may consider that the currents induced by the above methods are due simply to a **change** in the lines of magnetic force with respect to the conductor. A similar change may be produced in the field of an electromagnet by altering the intensity of the current which flows through it and produces the field. If the current be rapidly turned on and off, for instance, it will set up an induced current in any conductor which lies across the lines of force. It is upon this principle that the **induction coil** operates.
- **E. Alternating Currents:** Currents produced by altering the intensity of primary currents are of the type called **alternating,** that is they flow first in one direction then in the opposite direction. The reason for this will be apparent when we consider that the cause of the induced current is the "expansion" and

"contraction," so to speak, of the lines of force in the field of the primary, as the current alternately waxes and wanes. We saw above how the direction of motion across the lines of force affected the direction of the induced current. In this light, the "expansion" and "contraction" of the lines of force across the secondary conductor has exactly the same effect as a constantly repeated change of direction of motion.

Chemistry

I. **CHEMICAL VIEW OF MATTER:** The problem of what matter really is, belongs to the physicist. The chemist uses a special viewpoint suited to his particular studies. We can best get this viewpoint by seeing how the chemist views substances such as iron, iron-rust, and table salt.

A. **Pure Substances:** All specimens of pure iron show the same set of properties—gray color, hardness, etc. All specimens of iron-rust show a different set, peculiar to rust. Table salt shows still another set of properties. The chemist calls any definite kind of matter, whose specimens all show the same properties, a **substance**. Iron therefore is one substance, rust another, and table salt still another, because each one exhibits peculiar and **invariable** properties.

a. **Physical State:** A substance may be either solid, liquid, or gaseous.

b. **Crystalline and Amorphous Substances: 935.** If the particles of a solid substance have a definite and invariable form, the substance is **crystalline**. If the particles show no definite form, the substance is **amorphous** (meaning "without form").

B. **Mixed Substances:** It is perfectly possible to mix substances, and produce mixtures of fairly definite, **but not invariable,** properties. The component substances do not lose their identity and may be recovered by mechanical means from the mixture (711). A mixture of iron with table salt or with sulphur (712) is an example. The ingredients of a mixture are called **components** because they are simply placed together, without change, and can be separated without change. No one of the components affects any other component or alters any of its properties.

C. **Dissolved Substance and Solutions:** Many substances, such as iron in the form of filings, can be shaken up in liquid substances, such as water, without undergoing immediate change. Other substances such as salt, when mixed with water, promptly disappear or **dissolve.** They are recoverable, however, apparently unchanged, by mechanical means such as evaporation. When a solid disappears in a liquid, but without apparent change of its inherent properties, it is said to be **in solution.** The substance so dissolved is called the **solute,** and the liquid is called the **solvent.** The combination is a **solution.** If particles of a finely divided substance be shaken up in a liquid, but gradually settle out, the mixture is not a solution but a mere **suspension.** In a solution, the dissolved substance remains invisible and in solution.

D. **Disappearance of Substances and the Idea of Compounds:** While iron filings will disappear in time when placed in water, they do not dissolve, as salt does. They change to **iron-rust,** a substance entirely different from iron. The change is not a mere mixture; it is not a solution; it is a **genuine transformation of substance.**

— **Formation of Compounds:** Suppose we examine this rusting more closely by moistening the interior of a glass tube closed at one end, sprinkle some powdered iron upon the interior surface, and set the tube mouth downwards in a dish of water. As the moist iron slowly rusts, the water pushes farther up into the tube. Evidently part of the air has been absorbed and the water has been forced up to take its place. Apparently, then, this lost air or some part of it has **combined** with the iron to make rust (3099). Portions of two substances have **disappeared** and in their places **we have a new substance.** Such a union, in which the constituent substances have lost their identity, is called a **compound.**

E. **The Field of Chemistry:** The examination of such transformations in substance and the conditions under which they occur, constitutes the field of chemistry.

II. **ELEMENTS:** Countless experiments in the past and present have broken up many substances into constituent substances, and combined many substances to form others. In all these experiments, however, certain substances such as Iron, Copper, and Sulphur, stand out as unbreakable by ordinary chemical means. Such apparently irreducible substances are called **elements** (710–711). More accurately defined, an element is a substance that contains only atoms with the same nuclear charge (4040).

III. **COMBINATION OF ELEMENTS INTO COMPOUNDS:**

A. **Law of Combining Weights:** When we turn iron into rust as described above, only one-fifth of the air is used. This behavior indicates that whatever comes from the air to make rust forms one-fifth of the air's volume. Air therefore must be a mixture or compound, of which the "rusting substance" forms one-fifth by volume. Also, in any given case of rusting we find that for a certain consumption of the "rusting substance" in air, an invariable weight of iron changes to rust, and any excess of metal remains unrusted. If we weigh the amount of "rusting substance" consumed we find that the "rusting substance" (which we know to be the gas **Oxygen**) and iron always combine in the following proportions by weight: Oxygen (16): Iron (55.84). By experimenting with many elements in all sorts of combinations, we learn that every element has a certain combining ratio by weight with any element it joins to form a compound. From this we get the law of definite or constant proportions: **In every sample of any compound substance formed or decomposed, the proportion by weight of the constituent elements is always the same.** This characteristic weight is the combining weight of the element in that compound.

B. **Law of Multiple Proportions:** If we experiment with various elements we discover the following: While any given element may have different combining weights in the different combinations it enters, **the higher**

combining weights are always multiples of the lowest one obtained. This is the so-called "Law of Multiple Proportions."

C. The Atomic Theory: From these various phenomena, chemists long ago built up the atomic theory. This theory says that any given element is composed of minute, invisible particles, which are all alike in weight, and that the weight of the particle of that element is different from that of the particle of any other element. Such particles are called **atoms** (714). Since we cannot see any such particles, we must suppose them exceedingly small. If then we suppose that compounds are formed by union between the atoms of the elements concerned, the phenomena of "combining weights" and of "multiple proportion" become clear. If, for example, two elements combine atom for atom, it does not matter what quantities of the two elements be used; the total weight of each element entering into the compound will be in the same ratio as the weights of the two kinds of particles. If the combining weight of an element in one compound is twice as great as in another compound, we need only say that two atoms of the element have entered into one compound while only one atom entered into the other.

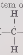
- **a. Molecules:** When atoms of two or more different elements unite to form a compound, the smallest possible particle of this compound is called a **molecule** (714). When the atoms of an element are unmixed with those of another, and thus give us a pure element, such as we have in a piece of iron, the atoms usually combine in pairs. These are known as **molecules of the element.**
- **b. Electrons:** As explained in the article on Atoms and Electrons (256), physicists now have shown that the atoms of elements are not indivisible, as formerly supposed, but really consist of **electrons** in various combinations. Since in all ordinary chemical work, however, the atoms remain indivisible, we may still say that **atoms are indivisible so far as practical chemistry is concerned.**

D. Atomic Weights: If we assign an arbitrary number to express the weight of one atom of an element, we can express the comparative weight of an atom of any other element in terms of the element chosen as a standard. Such a method gives us the so-called **atomic weights** of the elements. Formerly, chemists used the lightest element, the gas **Hydrogen,** with a value of **1,** as the standard. Now **Oxygen,** with a value of **16,** is used, both because its greater variety of activity permits more combinations to be made with it, thus making comparison of combining weights easy, and because it gives more atomic weights of the other elements in whole numbers. The atomic weights of the known elements are given on page 4042.

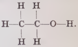
E. Chemical Symbols for Elements and Simple Compounds: In order to write out their data quickly, chemists have invented the following "shorthand" system:

- **a. For Elements:** Every element is assigned an initial, as **H** for Hydrogen, **C** for Carbon, etc. When two or more elements would have the same initial letters under this system, another letter is added to the initial to distinguish them, as **Ca** for Calcium, **Cl** for Chlorine. The symbol is frequently based on the Latin name, as **Fe** for Iron (*ferrum*) and **Pb** for Lead (*plumbum*), or on the name in some other foreign language. The symbols are chosen by international agreement and the same symbols are used throughout the world by chemists.
- **b. Formulae and Simple Chemical Equations:** The composition of simple compounds can be stated by setting down the necessary symbols for the elements, and the result is a **formula.** For example, **Ferrous Sulphide** (712) may be indicated in symbols as **FeS** (**Fe** for Iron, and **S** for Sulphur). A mere mixture of Iron and Sulphur (712) is shown by the plus sign, thus: $Fe + S$ (715–6). When the mixture is fused into Ferrous Sulphide by heat (712), we indicate the change by an arrow, thus: $Fe + S \rightarrow FeS$. Such an array of symbols, showing a transformation, is called a **chemical equation.** When only a single atom of an element is used in forming a compound, the symbol for that element is given without qualification (as **Fe** or **S** in this case). But when more than one atom of an element is present in a compound, we indicate it by a small number placed at the lower right hand corner of the symbol, as H_2O, meaning that **two** atoms of Hydrogen have combined with **one** atom of Oxygen. When more than one molecule is concerned in an equation, we put the number in front of the symbols describing the molecule. Thus two molecules of water is written $2H_2O$.

F. Valence: It has been found that the atoms of different elements possess in varying degrees the power of combining with atoms of other elements. Thus an atom of Hydrogen or an atom of Chlorine can never seize and combine with more than **one** atom of any other element. One atom of Oxygen, however, can seize and combine with **two** atoms of another element, while one atom of Carbon can seize and combine with **four** atoms of another element, and so on. This "capacity for combination" in an element is known as its valence. If we regard an atom as combining by means of hands, and we say that a chemical union is forming by clasping hands, one from each of the elements combined, we see that Hydrogen and Chlorine, have only one "hand" each, that is, they have a **valence** of one; Oxygen has two hands, or a **valence of two;** and Carbon has four hands or a **valence of four.** In the combination of Carbon and Oxygen to form Carbon Dioxide (CO_2), the four hands of the carbon may be regarded as clasping the two hands extended by each of the two Oxygen atoms.

- **a. Representing Valence:** The usual way of representing valence in chemical formulae is by means of lines, thus: **H—**, **—O—**, **=C=** or $\begin{array}{c}|\\ -C-\\ |\end{array}$. Hydrochloric Acid (**HCl**) on this system of using lines, would be pictured as **H—Cl**, Water (H_2O) as **H—O—H**, and Methane (CH_4) as  $\begin{array}{c}H\\ |\\ H-C-H\\ |\\ H\end{array}$.

- **b. Each Element Combined Must Contribute a Valence:** An atom of Chlorine, for instance, cannot seize upon an atom of Hydrogen while the Hydrogen is united to Oxygen. The Hydrogen must first be disengaged in order that it may contribute its valence to the union—that it may "clasp hands," so to speak, with the chlorine.
- **c. Valence toward Hydrogen and Oxygen:** Experience has shown that many elements have one valence toward Hydrogen and elements resembling Hydrogen, while they have another valence toward Oxygen and elements resembling it. Thus, Nitrogen usually exhibits a valence of three (III) toward Hydrogen and towards such elements as Chlorine, which resemble Hydrogen chemically; but toward Oxygen, Nitrogen often exhibits a valence of five (V).

G. Empirical and Structural Formulas: We have seen that a compound may be written by using the chemical symbols and little numbers. Thus, grain alcohol can be shown as C_2H_6O, since one molecule contains atoms in the proportions shown. Such a formula is called an **empirical formula.** But by using the line-system of exhibiting valence, we can express formulae in a way that shows the chemical relation of the atoms to each other within the molecule. On this system, grain alcohol would be  $H-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-O-H$. A formula written in this manner is called **graphic.** A shorter way of exhibiting the same fact is to write grain alcohol thus: C_2H_5OH. This style is known as a **rational formula.** Both graphic and rational formulas are classed as **structural.**

H. Radicals: We know that Sulphuric Acid is composed as follows: H_2SO_4. When it combines with, say, Potassium, we get so-called Potassium Sulphate, K_2SO_4. With Copper we get $CuSO_4$, and so on—the SO_4 always being present. Such a group, persisting characteristically throughout a set of related phenomena is called a **radical.** In this case, SO_4 is the radical of Sulphuric Acid; and this acid forms **salts** combining its radical with other elements in proportion to their "hydrogen valences." Another radical is Hydroxyl (**OH**), which unites with a Hydrogen atom to form Water, an atom of Sodium to form Sodium Hydroxide (**NaOH**) or caustic soda, and so on. Grain alcohol, as described above, is a combination of two radicals—the "ethyl" radical, or C_2H_5, and **OH.** If instead of the "ethyl" radical we have methyl (CH_3), the result is **methyl** or "wood" alcohol.

NATURE AND TYPICAL PHENOMENA OF CHEMICAL ACTION

I. ELECTRICAL NATURE OF CHEMICAL AFFINITY:

A. Structure of the Atom: Within the last two decades, physics has developed the idea that matter is composed of electrons (256). In detail, the new theory claims that any atom consists of **(1)** a central nucleus bearing a charge of positive electricity, and **(2)** one or more negative electrons circling planet-like about the central nucleus, their combined charges being sufficient to balance the positive charge on the nucleus. According to this theory, the atoms of different elements differ from each other only in the mass of the central nucleus and the amount of electricity borne by it, and the number of negative electrons present.

B. Affinities between Atoms: The addition or loss of a negative electron upsets the normal balance within the atom, and gives it an electric charge (See Physics Outline). This charge attracts charges of unlike nature borne by other "unbalanced" atoms, thereby creating the attraction between atoms which we call "chemical affinity."

C. Structure of the Radioactive Atom: In atoms of elements such as Radium (2959), the lack of balance between the positive and negative portions of the atom is so great that the atom expels from within itself a positive or negative particle, and regroups the remaining atoms into a stable system. Expelled positive particles are called **alpha** particles (2960); expelled negative particles are called **beta** particles (2960); so-called **gamma** rays (2960) are electromagnetic waves of exceedingly short length set up by the disturbance within the atom. The atom resulting from this "internal explosion" is a definite chemical element different from Radium. After passing through several stages of disintegration, each one constituting an element called a "radium emanation," Radium eventually attains a stable form as Lead (2959).

II. BASIC PHENOMENA OF CHEMICAL AFFINITY:

A. Types of Chemical Action:

- **a. Combination:** When elements or radicals unite, we have a case of **chemical combination.**
- **b. Decomposition:** When a compound breaks up into its constituent elements or radicals we have **chemical decomposition.**
- **c. Substitution:** When two compounds exchange their constituent parts, we have a case of **substitution** or **displacement.**
- **d. Catalysis:** Many elements and radicals which will not combine of themselves, do so readily in the presence of certain substances, which apparently do not themselves enter into combination. The presence of spongy platinum, for example, unites oxygen and hydrogen (2831). Substances which do this are called **catalysts.**

III. EFFECT OF SOLUTION UPON CHEMICAL AFFINITY:

A. Physical Properties of Solutions: A dissolved substance is believed to disappear in a solution because its particles break up into their constitutent molecules, and the molecules diffuse, or become dispersed, among the molecules of the liquid. The degree to which a substance will disappear in this way is called its **solubility.**

- **a. Concentration:** The proportion of dissolved molecules to the molecules of the liquid is called the **concentration** of the solution. A **dilute** solution is one with small concentration.
- **b. Saturated Solutions:** When once dissolved, the molecules of the solute wander about and from time to time encounter each other. When this happens they tend to resume their solid form. Obviously, the more molecules dissolved, the greater will be this tendency; and at a certain point the tendency to solidify again equals the dissolving tendency of the liquid. Then no more molecules can pass into solution, and the liquid is said to be **saturated.** Since heat increases molecular activity, it increases the tendency of molecules to separate. This reinforces the natural dissolving tendency. Therefore heating a liquid raises its **saturation point.**
- **c. Diffusion:** The tendency of all dissolved substances is to diffuse within the solution until the concentration of the latter is the same at all points. This phenomenon gives rise to "diffusion pressure" or "osmatic pressure" (2825–6) in solutions.

B. Dissociation: When compound substances are dissolved in water, the bonds uniting the constituent elements or radicals are weakened, and the compound tends to fall apart into electrically charged portions called **ions.** This "falling apart" is called **dissociation.** Substances other than acids, bases, and salts will not ionize when dissolved in water.

IV. CHEMICAL AFFINITY AND ELECTRIC FORCE: The theory concerning the electrical structure of the atom naturally suggests that any given chemical element may display one of three different types of electrical affinity. If the atom is practically balanced electrically, we expect to find it with practically no affinity, or tendency to combine. This would explain those elements which are **inert,** or inactive chemically. The active elements we might expect to find divided into the **electropositive** group and the **electronegative** group, subject, of course, to the condition that an atom may be so unstable as to have both positive and negative affinities, and be only predominantly one or the other. That is, a given kind of atom might have a greater average positive charge, but a strong positive charge on a neighboring atom might bring its negative charge into play. Although scientists suspect that all chemical affinity is really electrical, the most clean-cut case, and the only one they have worked out adequately, is in the case of substances which ionize in solution. The phenomena may be divided into two classes: **(1)** Those where electric current is created; and **(2)** those which are caused by electric current. In either case, the substance in solution is called the **electrolyte** and the conducting wires which lead away the current created or introduce the current which causes the phenomena are called **electrodes.**

A. Creation of Electric Current: As we have seen, substances which dissociate when placed in solution break up into ions with positive and negative charges. To take a simple case, Sulphuric Acid ($\mathbf{H_2\,SO_4}$) breaks up into Hydrogen-ions, with a positive charge and Acid-Radical-ions with negative charge (SO_4). Suppose now that rods of Copper and Zinc are inserted in the solution. What happens? The $\mathbf{SO_4}$ ion has a greater affinity for Zinc than for Copper. It therefore detaches particles from the Zinc plate, and unites them to itself to form Zinc Sulphate ($\mathbf{ZnSO_4}$). Since the Zinc atom must lose a negative electron in order to acquire the positive charge needed for the union, it follows that the Zinc plate rapidly becomes filled with free negative electrons. That is, it acquires a "negative charge." In the meantime, the hydrogen atoms in their wanderings have encountered the copper plate. If there be a connecting wire between the zinc and copper plates, the negative electrons at once rush through it in response to the attraction of the positive charge born by the hydrogen-ions. This flow constitutes an **electric current** and is explained by the picture on page 1109.

B. Phenomena Caused by Electric Current—Electrolysis: When the above process is reversed—that is, when current is supplied to a solution, rather than created by it—we have the phenomena known as **Electrolysis** (1125).

C. Electromotive Series: The following series of metals with Hydrogen are arranged in such order that any member of the series tends to displace any of those listed after it from union with oxygen and electronegative acid radicals: **Potassium, Sodium, Calcium, Magnesium, Aluminum, Manganese, Zinc, Chromium, Iron, Nickel, Tin, Lead, Hydrogen, Copper, Bismuth, Antimony, Mercury, Silver, Platinum, Gold.** In electrolysis the electromotive force of the current required to deposit each metal is less than that for the metal preceding it.

GENERAL PROPERTIES OF ELEMENTS

I. FAMILIES OF ELEMENTS: Experiments show that many elements can be placed together in groups called families, all members of the group having similar properties. The most conspicuous example is the **halogen family** (755), with Fluorine, Chlorine, Bromine, and Iodine. Another example are the **inert gases** (50), Helium, Neon, Argon, etc.

II. PERIODIC LAW: The existence of families and similar evidences of allied behavior long ago convinced chemists that there must be some simple way of arranging elements so that related groups would fall into order. The most obvious plan was to arrange them according to atomic weight, and in 1869 Mendeleeff, by leaving hydrogen out of account, succeeded in producing the so-called **periodic system** of elements. The table found on the next page shows them arrayed in the latest form of this system. You will also notice several gaps in the table. These were left in order to bring the elements following into their proper chemical relations. That this procedure is valid may be seen from the fact that Mendeleeff's original table had many more gaps, left for the same reason, and that as elements were discovered since his time, **they were invariably found to fit gaps in his scheme.** These gaps therefore represent elements still unknown.

III. BINARY COMPOUNDS: Many unions of two elements, which do not form either acids or salts, and which are

TABLE OF ELEMENTS ACCORDING TO THE PERIODIC SYSTEM

In the table, the name of each Element is printed in bold-face type, thus: **Hydrogen.** The chemical symbol follows immediately after, in parentheses, thus: (H). The Atomic Weight is printed in bold-face figures, thus: **1.008**. The Specific Gravity is printed in italic figures, thus: *.061*. Where the specific gravity is marked with a dagger (†) it is the specific gravity as compared with Air. The mark § for Carbon indicates that the specific gravity given is that of carbon when in diamond form. Where no specific gravity is shown, it is unknown or not satisfactorily determined. Notice that the first two horizontal rows contain roman numerals and are marked **H** and **O** at the extreme left hand end. Those roman numerals indicate the usual valence of the elements beneath them for Hydrogen and Oxygen respectively. When the valence is variable, the fact is indicated by a star (*). The element **Beryllium** is sometimes called **Glucinum (Gl)**.

HYDROGEN (H) 1.008 *.061*

H	O	I	II	III	IV	III	II	I	O
O	O	I	II	III	IV	V	VI	VII	VIII or Variable
	Helium (He) **4** *.1367*†	**Lithium (Li)** **6.94** *.585*	**Beryllium (Be)** **9.1** *1.93*	**Boron (B)** **10.9** *2.5*	**Carbon (C)** **12** *3.52*§	**Nitrogen (N*)** **14.01** *.967*†	**Oxygen (O)** **16** *1.105*†	**Fluorine (F)** **19** *1.265*†	
	Neon (Ne) **20.2** *.688*†	**Sodium (Na)** **23** *.978*	**Magnesium(Mg)** **24.32** *1.74*	**Aluminum (Al)** **27.1** *2.58*	**Silicon (Si*)** **28.3** *2.0–2.4*	**Phosphorus(P)*** **31.04** *1.8–2.3*	**Sulphur (S*)** **32.06** *2.07*	**Chlorine (Cl)** **35.46** *2.488*†	
	Argon (A) **39.88** *1.378*†	**Potassium (K)** **39.1** *.87*	**Calcium (Ca)** **40.07** *1.58*	**Scandium (Sc)** **44.1**	**Titanium (Ti)** **48.1** *3.54*	**Vanadium (V*)** **51.06** *5.5*	**Chromium (Cr)** **52** *6.5*	**Manganese(Mn)** **54.93** *7.39*	**Iron (Fe*)** **55.85** *7.86* **Cobalt (Co*)** **58.97** *8.6* **Nickel (Ni*)** **58.68** *8.9*
		Copper (Cu) **63.57** *8.9*	**Zinc (Zn)** **65.37** *7.12*	**Gallium (Ga)** **69.9** *5.95*	**Germanium (Ge)** **72.5** *5.47*	**Arsenic (As)** **74.96** *5.73*	**Selenium (Se)** **79.2** *4.5*	**Bromine (Br)** **79.92** *3.15*†	
	Krypton (Kr) **82.92** *2.82*†	**Rubidium (Rb)** **85.45** *1.52*	**Strontium (Sr)** **87.83** *2.54*	**Yttrium (Yt)** **88.7** *3.8*	**Zirconium (Zr)** **90.6** *4.15*	**Columbium (Cb)** **93.5** *12.7* Note: This element is also called **Niobium** (Nb).	**Molybdenum(Mo)** **96** *8.6*	....	**Ruthenium(Ru*)** **101.7** *12.26* **Rhodium (Rh)** **102.9** *12.1* **Palladium (Pd*)** **106.7** *11.4*
		Silver (Ag) **107.88** *10.5*	**Cadmium (Cd)** **112.4** *8.64*	**Indium (In)** **114.8** *7.4*	**Tin (Sn)** **118.7** *7.3*	**Antimony (Sb)** **120.2** *6.62*	**Tellurium (Te)** **127.5** *6.0*	**Iodine (I)** **126.92** *4.95*	
	Xenon (Xe) **130.2** *4.42*†	**Caesium (Cs)** **132.81** *1.88*	**Barium (Ba)** **137.37** *3.75*	**Lanthanum(La)** **139** *6.1*	**Cerium (Ce)** **140.25** *6.68* See Note below for other elements of this group.	**Tantalum (Ta)** **181.5** *10.4*	**Tungsten (W)** **184** *19.1*	....	**Osmium (Os*)** **190.9** *22.48* **Iridium (Ir)** **193.1** *22.4* **Platinum (Pt*)** **195.2** *21.5*
		Gold (Au) **197.2** *19.3*	**Mercury (Hg)** **200.6** *13.596*	**Thallium (Tl)** **204** *11.85*	**Lead (Pb)** **207.2** *11.37*	**Bismuth (Bi)** **208** *9.8*	**Polonium (Po)**	....	
	Niton (Nt) (Radio element) **222**	....	**Radium (Ra)** **226**	**Actinium (Ac)** **226**	**Thorium (Th)** **232.15** *11.00*		**Uranium (U)** **238.2** *18.7*		

Note: Grouped with Cerium are the following "rare earth" elements: **Praseodymium (Pr) 140.6**, *6.48*; **Neodymium (Nd) 144.3**, *6.96*; **Illinium (Il)**, atomic weight not yet determined; **Samarium (Sa) 150.4**, *7.7*; **Europium (Eu) 152; Gadolinium (Gd) 157.3; Terbium (Tb) 159.2; Dysprosium (Dy) 162.5; Holmium (Ho) 163.5; Erbium (Er) 167.7; Thulium (Tm) 168.5; Ytterbium (Yb) 173.5; Lutecium (Lu) 175; Hafnium, 179.**

usually insoluble, are known as **binary compounds.** The compound is usually named for the two elements, with the name of the metallic element first, having the ending **-ic** or **-ous**, with the other name ending usually in **-ide.** If the elements can combine in different proportions, the **-ic** ending is used for the compound containing the smaller proportion of the metallic element. Examples: Ferric sulphide (Fe_2S_3) and Ferrous Sulphide (**FeS**).

IV. ACIDS: 8. Long before much was known of chemistry, people recognized an affinity between certain substances, sour in taste, and generally destructive of metal, known as **acids.** Chemistry recognizes this grouping as valid, and adds that an acid is a compound of Hydrogen with an electronegative element or radical. Common acids are: **Sulphuric** (3390), **Nitric** (2510), **Hydrochloric** or **Muriatic** (1710, 755) **Carbonic** (642, 571), **Boric or Boracic** (151, 464), **Hydrocyanic or Prussic** (944, 2855), **Picric** (641, 1212), **Silicic** (3234).

- **A. Solubility:** Acids are generally soluble and dissociate in solution.
- **B. Tests for Acids:** The commonest tests consist of introducing substances which change color in the presence of acid. The most frequent test is made with **litmus** (10).

V. BASES: 10. A base is a compound formed with the hydroxyl radical (**OH**). Solutions of such compounds have a soapy feeling and a bitter taste, and give reactions opposite to those of acids when subjected to the litmus test. Since the hydroxyl radical is electronegative, it tends to unite with electropositive elements, called the **base-forming elements.** Among these base-forming elements are the following: the Metals (2201); the Alkali Metals, Lithium, Sodium (3271), Potassium (2898), Rubidium, Caesium; the Alkaline Earths Calcium (571), Barium 1472, 2776, 2642), Strontium.

- **A. In General, Bases are Soluble and Dissociate in Solution.**
- **B. Phenolpthalein Test:** Phenolpthalein ($C_{20}H_{14}O_4$) is a complex organic compound with feeble acid properties. When in solution it does not react to acids, but turns red in the presence of a base.
- **C. Alkalies: 8.** An alkali is simply a base formed with one of the alkali metals or the radical Ammonium (NH_4). Note that ammonium is not the same as Ammonia (NH_3).

VI. SALTS: 10. We have seen that both an acid and a base consist of an electronegative radical, combined with an electropositive element or radical. A salt has the same structure, save that the electropositive element **cannot be hydrogen,** and the electronegative radical **cannot be hydroxyl.**

- **A. Behavior:** Salts dissolve in water and dissociate. They do not react to any of the tests for acids or bases; that is, a salt solution will not turn red litmus blue or blue litmus red. For this reason they are called **neutral.**
- **B. Formation by Reaction between Acids and Bases:** Salts are commonly formed by placing an acid and a base together. When this is done, and exchange of electropositive elements takes place, the Hydrogen of the acid unites with the hydroxyl of the base to form water, and the electropositive element or radical of the base unites with the acid radical to form a salt.
- **C. Formation by Reaction between Acids and Metallic Elements:** A metal and an acid react to form a salt, if the metal stands higher in the Electromotive Series (see above) than Hydrogen. On the other hand, a combination of free Hydrogen and a salt forms acid and a free metal, if the metal stands below Hydrogen in the Electromotive series.
- **E. Acid and Basic Salts:** If either the electropositive or electronegative fraction of a salt has more than one valence, and the salt-making process is completed for every valence, we get a complete or **neutral** salt. Sodium Sulphate (Na_2SO_4) and Calcium Chloride (Ca_2Cl) are examples. If the process is incomplete, we get "half-way" salts as follows: **(a)** If an acid radical has more than one valence, and all of the hydrogen is not displaced, we get an **acid salt,** with an acid reaction to litmus and some of the properties of a salt. Acid Sodium Sulphate ($NaHSO_4$) is an example; **(b)** If an element with more than one valence has been combined with hydroxyl radicals, and all the hydroxyl is not displaced, we get a **basic salt,** with a basic reaction to litmus and some of the properties of a salt. Basic Calcium Chloride (**CaOHCl**) is an example.
- **F. Mixed and Double Salts:** When the salt formation is complete, but more than one element or type of radical has displaced the Hydrogen or hydroxyl, we have a **mixed salt.** Sodium-Potassium Carbonate ($NaKCO_3$) is an example. When two or more salts are chemically united, we have a **double salt.**

CHEMISTRY OF CARBON COMPOUNDS

FIELD COVERED: This branch of chemistry is often called **Organic Chemistry,** because at one time it was supposed that only living organisms could produce the substances studied.

- **A. Nature of Organic Compounds:** Organic compounds consist typically of various radicals, arranged in different combinations, but all containing carbon. Hence it is important to know: **(1)** the principal radicals; and **(2)** the principal substitution compounds.
- **B. Important Radicals:**
  - **a. Hydro-Carbons:** Radicals containing Carbon and Hydrogen only.
    - **1. Open-chain, Saturated, or Paraffin Series:** In these radicals, Carbon atoms are united in a line or "open chain," thus: $-\overset{|}{\underset{|}{C}}-\overset{|}{\underset{|}{C}}-$ . . . , with Hydrogen grouped about the edge. Important members: Methane (CH_4), Ethane (C_2H_6), Propane (C_3H_8), Butane (C_4H_{10}), Pentane (C_5H_{12}). This group is often called the paraffin series because many of its members are found in paraffin. The type formula of this group is C_nH_{2n+2}, which means that the number of Hydrogen atoms is equal to twice the number of Carbon atoms plus two. The names of the radicals end in **-ane.** When a Hydrogen atom is removed, in order to permit entering into combination, the ending changes to **-yl.** Examples: Methane, CH_4, Methyl, CH_3.

2. **Ethylene Series:** These radicals have certain carbon valences unsatisfied, and are of the type: C_nH_{2n}. Example: Ethylene (C_2H_4), a constituent of illuminating gas.
3. **Acetylene Series:** Type formula: C_nH_{2n-2}. Example: Acetylene, C_2H_2.
4. **Benzene Series, "Closed Chain," or Aromatic Series:** This is an exceedingly important series, in which the carbon atoms are linked in one or more closed rings. Type formula: C_nH_{2n-6}.

b. **Carbohydrates:** Carbohydrates are radicals containing Carbon, Hydrogen, and Water, the latter in the proportion of 2 to 1. On treatment with dilute acid, they all become monosaccharide sugar. Only a few of the most important can be mentioned:

1. **Monosaccharides: 3388.** These are compounds of the type $C_6H_{12}O_6$, differing chiefly in optical and complex chemical properties (2000). Examples: Glucose (1475); Fructose (3388).
2. **Disaccharides:** These consist of two monosaccharide molecules, less the equivalent of a water molecule, in combination. Typical formula: $C_{12}H_{22}O_{11}$. Examples: Sucrose or Cane Sugar (3388–9), Maltose (3388), Lactose (3388).
3. **Polysaccharides:** Contain more than two monosaccharide molecules, less the equivalent of some water, in combination. Typical formula: $(C_6H_{10}O_5)$. Examples: Starch (3344) and Cellulose (673).

C. **Substitution Compounds:** These are formed by substituting elements or radicals for Hydrogen atoms in organic and a few inorganic radicals. Only a few of the enormous number can be given as examples:

a. **In Open-Chain Radicals.** Two important substitution compounds of Methane (CH_4) are: **Chloroform,** $CHCl_3$ (three atoms of Chlorine displacing three of Hydrogen), and Iodoform, CHI_3.

b. **In Benzene Radicals:** Substitution of one Hydroxyl Molecule (OH) in the Benzene ring (C_6H_6) gives Carbolic Acid, C_6H_5OH (641), which is not a true acid. Substitution of Methyl (CH_3) gives Toluene ($C_6H_5CH_3$). Substitution of nitro groups (NO_2) gives various high explosives, T.N.T., or **Tri-Nitro-Toluene,** being an example.

D. **Substitution Compounds in Ammonia (NH_3):**

a. **Amines:** These are formed by substituting one or more organic radicals for the Hydrogen atoms of Ammonia. They are called amines, di-amines, or tri-amines according to the number of **H** molecules displaced. Example: Methyl Amine (CH_3) NH_2.

b. **Amides:** These are similar to amines, save that the substituted radical must be an **organic acid.**

COLLOIDS AND THE COLLOIDAL STATE: In the first part of the Outline we divided solid matter into crystalline and amorphous forms, and said that when the solids are placed in a solute, they either remain in suspension or dissolve. There is one important exception to this rule, namely, the substances known as **Colloids.**

A. **Colloidal Suspension and Solutions:** In a **suspension,** the particles of insoluble substances remain unchanged in their crystalline or amorphous form, and are kept from settling at once only by the impact of the moving molecules which make up the solvent. In a **solution,** the particles break up into individual molecules, and these, being practically as light as the molecules of the solvent, remain suspended indefinitely. There is, however, an intermediate state known as **colloidal suspension,** taken by various kinds of substances, usually those with high molecular weight. In this state the dissolved particles break up, but not completely, and bear electric charges. The resulting particles are large enough to be detected by the ultra-microscope, and their weight, while great enough to make them settle out in time, is prevented from acting by their electric charge. That is, as such particles settle downward, the electric charge of particles already in the lower part of the liquid drives them upward again. Thus they are kept evenly distributed throughout the solution. Any substance which enters into colloidal suspension is called a **Colloid.**

Books on the Physical Sciences

GENERAL

The Sciences. Edward S. Holden.
Experimental Science. George M. Hopkins.
Short History of Natural Science. Arabella B. Buckley.
Story Lives of Men of Science. F. J. Rowbotham.
Children's Stories of the Great Scientists. Henrietta C. Wright.
Boys' Playbook of Science. John Henry Pepper.
Outline of Science (4 vols.). Edited by J. Arthur Thompson.
Discovery—the Spirit and Service of Science. R. A. Gregory.

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Introduction to the Rarer Elements. Philip E. Browning.
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Outlines of Electrochemistry. H. C. Jones.
Argon and Its Companions. Sir William Ramsay and Morris W. Travers.
Elements and Electrons. Sir William Ramsay.
The Elements of Physical Chemistry. Harry C. Jones.
An Introduction to the Physics and Chemistry of Colloids. Emil Hatschek.
The Physical Chemistry of the Proteins. T. Brailsford Robertson.
Chemistry for Photographers. Charles F. Townsend.

ASTRONOMY

ASTRONOMY has been called the "Mother of all the Sciences." Long before any of the other great sciences had been organized, men were busy investigating the mysteries of the heavens, and out of the speculations and observations of these early "star-gazers" came some of the most profound scientific truths. Among the great names associated with Astronomy are those of Ptolemy, Tycho Brahe, Copernicus, Galileo, Kepler, Newton—all leaders in the science of their day. So we must not think that a knowledge of the Sun and the Moon, the Planets and the Stars is far removed from the practical affairs of our daily life. Not only is Astronomy fascinating and full of inspiration in itself, but an understanding of its chief principles is absolutely necessary to a proper grasp of most of the other branches of knowledge whose fields lie much nearer home.

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  - **c. Contributions of Tycho Brahe and Johann Kepler: 1920.**
- **C. Isaac Newton and the Discoveries that Revolutionized the Study of Astronomy: 2476.**

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Books for the Astronomy Student

THIRD TO SIXTH GRADES

Star-Land. R. S. Ball.
Stars Shown to the Children. Ellison Hawks.
Stars in Song and Legend. Jermain Gildersleeve Porter.
Earth and Sky Every Child Should Know. Julia Ellen Rogers.
Giant Sun and His Giant Family. Mary Proctor.
Stories of Starland. Mary Proctor.
Earth and Sky. Edward Singleton Holden.

SEVENTH AND EIGHTH GRADES

Boys' Book of Astronomy. Ellison Hawks.
Elements of Astronomy. Simon Newcomb.
Book of Stars for Young People. Geraldine Edith Mitton.
Astronomy with an Opera Glass. Garrett P. Serviss.
The Stars and Their Mysteries. Charles R. Gibson.
Astronomy from a Dipper. Eliot Channing Clarke.
The Romance of Modern Astronomy. Hector Macpherson.
Sun, Moon, and Stars. Agnes Giberne.
Book of Stars. Archie Frederick Collins.
Family of the Sun. Edward Singleton Holden.
The Sciences. Edward Singleton Holden.
Triumphs of Science. Martha A. L. Lane.
Trees, Stars, and Birds. Edwin Lincoln Moseley.
Wonders of Science. Eva March Tappan.

HIGH SCHOOL AND AFTER

Astronomy for All. B. H. Burgel.
The Call of the Stars. J. R. Kippax.
Comets and Meteors. J. R. Kippax.
The Ways of the Planets. M. E. Martin.
First Observations in Astronomy. M. E. Byrd.
Descriptive Astronomy: An Elementary Exposition of the Facts, Principles, and Theories of Astronomical Science. F. R. Moulton.
The Essence of Astronomy. E. W. Putnam.
Astronomy in a Nutshell. Garrett P. Serviss.
Astronomy. George F. Chambers.
The Destinies of the Stars. Svante A. Arrhenius.
Star and Weather Gossip. Joseph H. Elgie.
Splendors of the Sky. Isabel Martin Lewis.
Popular Guide to the Heavens. Sir Robert Ball.
Story of the Heavens. Sir Robert Ball.
Easy Star Lessons. R. A. Proctor.
Astronomy. Harold Jacoby.
The Moon in Modern Astronomy. Philip Fauth.
The Sun's Place in Nature. Sir J. N. Lockyer.
Modern Astronomy. H. H. Turner.
Evolution of the Stellar Systems. T. J. J. Consult.
Evolution of the Worlds. Percival Lowell.
Popular History of Astronomy. Agnes M. Clarke.

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MODERN EDUCATION
and
PROBLEM-PROJECT TEACHING

by WILLIAM B. OWEN

Principal of the Chicago Normal School and President of the National Education Association, 1922-23.

TEACHING implies a teacher and one who is taught. It is a form of communication between human beings. There is the further assumption that the teacher knows something that the one who is taught at least does not fully know and perhaps would like to know. Teaching is a very ancient form of human intercourse. It has an unbroken history from the times of the Greeks and Romans down to the present time. People who have taught successfully have left us a record of how they did it, written either by themselves or others. Then the process of teaching has been analyzed and described by students of the human mind and by practical teachers.

In modern times, particularly since the middle of the eighteenth century, there has been produced an extensive and valuable literature on the science and art of teaching. A careful study of this literature reveals the fact that each advance in our ideas and methods of teaching is dependent on and related to some new view of human nature, derived either from practical experience or from some science like psychology, physiology, or sociology, that treats of some aspect of human nature. Any treatment of teaching, it would seem, will inevitably bear the marks of the time in which it is written. To find a new theory and practice of teaching bearing a new and strange name challenges the attention and creates a demand to understand it in itself and also to find what new way of thinking about human nature gave rise to it. A very important illustration is the new view of teaching which bears the title at the head of this article. It is a thing of about a decade in its history. The treatment that follows will be set forth under the following heads:

I. Education
II. Teaching
    A. The Pupil
    B. The Teacher
    C. The Course of Study
III. The Problem Project Method
    A. The Project as Individual Thinking
    B. The Project as Social Thinking

I. EDUCATION

All sensible people value education. All civilized peoples have worked out some form of education. Even semi-civilized and barbarous tribes have what may be called a kind of education. Ever since the civilization which we have inherited had its beginnings among the peoples whose lands bordered the Eastern Mediterranean, education has been one of the means of maintaining and developing that civilization. Education has a history as well as government, agriculture, trade, manufacturing, art, music, science. One has to be educated in order to be civilized.

We speak of education in two senses. In the narrower sense, education is what we learn in school or in our vocations, when what we do is carried on primarily for the sake of what we learn or the training we receive. This may be called formal education. But we also receive education by participating in an activity or work that is not planned to educate us. A farmer's boy receives education in farming by helping his father in making hay. The father does not make the hay in order to educate his son, but that he may have feed for his horses and cattle in the winter. Such education may be called incidental education. Under one form or another education continues throughout life. No one can escape it. Experience shows, however, that in general those are best educated who have had an opportunity in the earlier years of their life to get the formal education that the institutions of their country provide. This statement, however, does not overlook the fact that many persons of great ability and industry have acquired a good education through their own efforts. They have made unaided use of the means of education afforded by the society in which they lived.

How We Educate Ourselves

This leads us to observe that on the one hand we educate ourselves and on the other hand we are educated by others. Education begins in the family and starts at birth. It is a great advantage to be born in a good family. Good habits, good books, good conversation, travel, right ideals, refined tastes, correct speech fashion the growing minds. The good family contributes to the success of the formal education received in school and college. No single institution alone, but all institutions coöperating educate us. And yet at the same time all education is self-education. Schools and other institutions constitute opportunities which we can neglect and disregard or seize and utilize. It is easier to get an education under good teaching than to go it alone. But a good teacher makes little headway with an unwilling or indifferent pupil. A poor teacher and a poor pupil defeat each other. A poor teacher cannot prevent a good and ambitious pupil from getting an education. Books, newspapers, pictures, acquaintances and friends, and the demands of our work in our callings and professions supplement and continue the formal education of the schools. We must not underestimate the contribution made to our education by the schools. But we are not likely to overestimate the extent to which we are responsible for educating ourselves, both in the schools and by the use of the means at hand outside the schools.

What We Mean by Education Today

We have been discussing education just as if we had already agreed on what we mean by it. In a broad sense, we do. But just as soon as we begin to go into it more deeply, it becomes necessary to come to an understanding about it, if we are to understand one another. There have been many definitions of education formed during the past centuries. No one seems entirely adequate. The older ones do not satisfy us because they do not fit our way of thinking today. Each seems to have been made to meet the needs of the time. Perhaps we must be content to adopt one that harmonizes with the thought of our own time.

For more than a century the scientific world and in consequence the practical world have been emphasizing the study of living things. Exploration and travel have brought to light countless new forms of plant and animal life. These have been studied, described, compared, and classified. Then the microscope has revealed their internal structure. Technical methods of staining and preparing their tissues have made this revelation more complete. The outcome of this study has been an increased knowledge of living things that has changed our way of thinking about them.

Moreover the methods of studying them and the conclusions drawn from this study have profoundly affected not only our thought but the language we use in older sciences that deal with human life in all its aspects. Because we use the term biology to cover the fields of plant and animal life, we say that we look upon life in general from the biological point of view. Perhaps the most fundamental fact about living things is that they grow. The individual grows from conception to maturity. The race grows by reproducing its kind. The processes by which life maintains growth through individual and race form the subject matter of the sciences that deal with living things. It is but natural therefore that this activity should affect our view of education. Some of the foremost students and writers on education have boldly adopted this fundamental notion and have defined education as growth.

What is Growth

To say that education is growth forces us to think more closely about growth. When we talk about living things growing we have several notions in mind. When a plant grows it increases in size. We mark the growth of children by measuring their height. Again growth may imply increase in weight. Standards of growth for children are expressed in terms of height and weight. Size and weight are the two most apparent measures of growth. There is at least one other, not so simple to apply, but really more important, namely differentiation in structure and function. Plants do not merely increase in size and weight as they grow. They change in shape and make-up. They do not expand like a toy balloon. They put forth leaves, they flower, they bear fruit, they produce seeds and shed them. Insects grow and many pass through wonderful changes in form and activity. Lower forms of animal life, like the frog, for example, rival the insects in their transformation. It is very easy to recognize stages in their growth.

Human beings grow in the same way. They increase in size and weight up to a certain point. They change in structure and function more than we are careful to realize. They pass through stages of growth. One of the most interesting and valuable fields of investigation of the present day is the growth of children. As a result of what has already been learned, the practice of education, in theory at least, has been greatly changed to the advantage of the children.

So far we have been talking about bodily growth. That is objective, can be observed and measured, recognized by all. Education is not merely bodily growth. We think of it chiefly as growth of the mind. And here we may profitably dwell on a result of the biological study that we have mentioned above that has had a great influence on our modern views of education. Until relatively recent times the mind with its activities has been studied as if it had an existence separate and independent of the body. Of course every one thought of the mind as being associated with the body. The mind used the body as an instrument. But the assumption was that the mind could be understood in disregard of the body.

Modern psychology, which is the science of the mind, takes the biological viewpoint. It is a mind-body psychology. It assumes that the life of the mind cannot be understood without taking into account the life of the body. Activities of the mind are followed by activities of the body. Activities of the body are followed by activities of the mind. A good deal of modern psychology is devoted to the working out of specific correlations between these two parts of the mind-body organism which we call a human being. Some of the relationships are easy to determine. We must stimulate the eye to produce color. Different wave lengths of light must reach the eye to produce the different colors. The papillae of the tongue must be stimulated to induce the taste of salt, sweet, bitter, sour. And so on with the various sense organs located throughout the body. Conversely, we can worry ourselves sick. Fear increases the heart action or causes us to faint.

More important than these more apparent relationships, there is a constant correlation between the action of the mind and that of the brain. If we could see and experiment with the brain as easily as we do with the eye, the ear, the hand, the skin, we should be able, perhaps, to understand and control the mind much better than at present. But we know enough to be able to say that the mind develops and grows as the body grows. There are stages of bodily growth. Education is growth. When the body has reached its maximum in size and weight, there is a growth in the brain that goes along with the growth of the mind. That growth is not chiefly one of size or weight, but of new connections between the elements of the brain structure. The details of this growth and the facts and laws of this mind-body life are what the science of psychology teaches us. Enough has been said to make clear why in our day it is both natural and reasonable to think of education as growth.

The Growth of Experience

Thus we have seen that we got the notion of education as growth from the study of the growth of the body and mind together and that a careful study of the body is necessary to an understanding of the mind. Yet we do not get all our idea of growth from that of the body. We have our own experience to draw on. Experience, too, grows. We believe that in some way our experience is always a mind-body experience. But we know a good deal more about it than we can get by studying the body alone. We can study our own experience first-hand. When we do, we recognize that we do not just have it. We take a hand in it, plan it, direct it, at least, as far as we can. The idea or concept of experience is fundamental in education. It is not possible to define it, but we all know what we mean. It is an inclusive term for all that we go through. In the case of each one of us, it reaches back as far as memory takes us. As we look back on it, we think of it as a continuous development.

We expect it to continue out into the future. We plan it ahead and strive to realize our expectations of it.

So we say that experience grows. It does not grow in size, in a strict sense, although it does enlarge, expand, lengthen. We measure it in time, not in space. Its growth is one of structure and organization. Its parts are connected together in new ways. Thus we use our experience to get new and different experience. It might be said that education is a process of getting, organizing, and enjoying experience. We can put the ideas of growth and experience together and say that education is a growth in experience, or a growth of experience.

II. TEACHING

Teaching is in some fashion the art of directing the growth of pupils in experience. No one definition will suffice to describe all that teaching is. Certain fundamental facts about it must be kept in mind if we are to understand it.

The pupil plays his part in the teaching process. The simplest way to describe that part is to call it learning. But learning may mean something too restricted, too narrow, like committing to memory. It is necessary to take a broader and truer view, if his part is to be understood. The teacher plays a part in the teaching process. One way to describe that part is to say that the teacher instructs. But this word, in turn, is too limited in its meaning. Instruction is but one phase of a much wider activity that the teacher carries on. To describe teaching correctly, or to carry it on successfully, one must take the larger view of the teacher's work.

But what the pupil does and what the teacher does is determined in large part by what the course of study or the curriculum lays down for the one to learn and the other to teach. That pupil and teacher may not work at cross purposes there must be a broad and clear idea of what a course of study really is, how it should be organized, what its meaning is, what its aims and results should be. The discussion of teaching that follows will be taken up under three heads: 1, the pupil; 2, the teacher; 3, the course of study.

A. THE PUPIL

There are three outstanding assumptions that underlie all modern theory in regard to human nature which must be kept in mind in any effort to understand the pupil's part in the teaching process. These assumptions or points of view are: (a) the pupil is active; (b) the pupil is individual; (c) the pupil is social. These points of view will be developed far enough to make it possible to understand the treatment of teaching which follows. Without such an understanding, the meaning, consistency, and real simplicity of the different subjects expounded might escape recognition.

(a) The Pupil as Active

It took the world many hundreds of years to arrive at the idea that the human mind is essentially active. In ancient times it was compared to a wax tablet on which words are written with a stylus. In modern times the same assumption was made when it was compared to a blank piece of paper ready to be written on. No wonder that education was thought of as consisting of committing to memory and the teacher's work that of impressing words on the pupil's mind. The same increase in knowledge that has led to the view that education is growth has forced us to the realization that the mind is aggressively and unceasingly active. Human nature is dynamic. The body is a machine that transforms energy. Food is taken into it and is used to build tissue and furnish the power to do work. This energy manifests itself in muscular movement, in locomotion, in lifting and pulling and pushing. It flows over into the nervous system and charges the brain. Through the sense organs the brain achieves contact with the world and is stimulated to respond in manifold ways. The current of dynamic power flows from the world into bodies and from bodies out into the world.

But as we have seen, the body is a mind-body organism. Bodily energy is but the one phase, while mind energy is the other. The mind is active even when we are asleep. There is little difficulty in accepting this view with regard to the outward activities of children. It is a common saying that they are never still, that they cannot sit still. They kick, walk, run, laugh, talk, play incessantly. Grown people keep still because they have learned how. Their minds are active in ways that do not appear on the surface. While they may be outwardly at rest, their minds are at work, remembering, imagining, planning, hearing, hating, loving. The outer world of men and things does not so much set them to acting as direct them into new ways of acting. In a fundamental sense they are always active. The vast new literature of education, particularly that dealing with children, cannot be understood unless one keeps in mind that it all is written from the fundamental assumption that has just been set forth.

(b) The Pupil as Individual

A second assumption is that each person or pupil is an individual. At first thought it would hardly seem necessary, much less important, to stress such an obvious fact. The necessity arises from the fact, to be emphasized later, that he is also social. He is both individual and social at the same time. Not only must it be recognized that there are these two aspects of the pupil's life, but it is of first importance to recognize when we are treating him as one or the other.

Again it is the last century that has led to the recognition of this twofold nature of human beings. The naive assumption is that each person has a separate life of his own, that he is a complete unit in himself. It was but natural, therefore, to think of him as self-contained, growing up within himself, getting his own education, living his own life. To be sure, all this is true of him according to the modern view as well. But when it comes to understanding and controlling his life and activity, it becomes necessary to take into account that he is as truly and constantly social as he is individual.

Certain outstanding factors in the individuality of a human being must be kept in mind. Every one has an individual body. This body has its own peculiar character. It is male or female, it is tall or short, heavy or slight. It has color, contour, carriage that is distinctive. Countenances are much alike yet different. Twins are hard for strangers to distinguish. Family likeness marks children of the same family. Yet it is claimed that no two people register identical finger-prints. While others identify our bodily appearance with more or less readiness, we have no such difficulty ourselves. We live with it, get familiar with its inner and outer feel, learn its strength and weakness, its skill and awkwardness, its fatigue and energy. It is a constant part of what we call ourselves.

But the body is not all of us. Each of us has a self. This self, when we come to think of it, seems to be the very centre and core of our being. It is more intimately "I" than even our body. The self persists through the days and years of our lives. Memory carries us back to early childhood and it is the same self at the dawn of recollection. To be sure, the self has grown with the body through the years. It has broadened out, has experienced many times and places and people and things. It has overcome weaknesses and faults. It has acquired courage, skill, knowledge, forethought, wisdom. The self has peculiar habitats. It is one kind of a self in the family, another in the school, another in business, another in public life. Though it seems to be many, it does not cease to be one.

It is the individual self that is contemplated by most of our educational literature and the practice of the schools. Intelligence tests are given to find what individual ability a pupil possesses. Achievement tests attempt to rate his attainment in arithmetic, reading, writing, English composition, and the like. Other tests are being devised to enable teachers to compare the mechanical skill and the social ability of individual pupils with others.

(c) The Pupil as Social

But the pupil is also social. Briefly stated, this means that his life is carried on in some sort of interaction with others. Put in other words, his activity can be understood only as other human beings are taken into account. Every child is born of a social group and born into a social group. His body is social in its origin and its reference. Through his parents he combines two family stocks. He reproduces in himself qualities of his forebears. His abilities are inherited. His temperament and talents are likewise inherited. He is endowed to respond to stimuli proceeding from others. His impulses and instincts are called out and directed toward people. Fear, laughter, anger, pride, shame, emulation, love, hate, all imply a world of others. Gesture, language, communication are manifestations and results of a social nature. Sympathy, suggestion, imitation are conceivable only in a world where other selves or people are.

The varied activities, emotions, and tendencies enumerated above are sufficient to make clear what is meant by saying that the pupil is social. He is by nature adapted to a social environment and that environment actually releases and directs his active, social nature. Another consideration is of fundamental importance. The child is born into a going society. From the very first, society, through the groups in which he lives, imposes on the child its customs and habits. He is thus changed into the likeness of the people about him. His language, habits of eating, working, playing, sleeping are taken over. The family into which he is born leaves its impress on him before he goes to school. The school, in turn, puts him through a process of acquiring habits, skills, and ideas that increase enormously his power to react to society. At any point then, a child or a pupil must be thought of not only as individual, but as social, if he is to be understood, directed, and educated.

Modern progress in education has been determined chiefly by the effort made to understand the growth of children and to make teaching, schools, and the whole life of children in and out of schools favorable to that growth. To think of children as dynamically active, as being individual and at the same time social is to place oneself at the point of view from which the development in teaching method and technique is best understood and best mastered.

B. THE TEACHER

All that has been said about the pupil would hold true in kind of the teacher. She is older, knows more, has been trained to teach, has authority and prestige and has her main purpose fixed by her calling. She is present to teach the pupils. But just what precisely she is to do depends on what the nature of teaching is. In the past, when the school was supposed to fix in the minds of the pupils a fixed and given subject matter, the teacher's work seemed very definite. The pupil was supposed, particularly in early years, to be a sort of memorizing machine. Repetition was regarded as the fundamental law of memory. The teacher's task, therefore, was to secure an adequate amount of committing to memory either in school or out of school. The class-room activity of the pupil was to recite, that is, to repeat aloud what the teacher had assigned to him to learn, so that the teacher might know that he had learned it. Often this recitation was an individual matter between the pupil and the teacher. Competition between pupils in learning and reciting was introduced to stimulate effort.

Now learning is a very important part of education. Modern educational method is laying great stress on this part of school work. We are learning how to learn. Many experiments have been carried on to find out under what conditions learning is best carried on, just how and when to repeat in order to fix firmly in the memory. Tests are devised to measure how well something has been learned. But the difference between modern education and the older education lies in the fact that memorizing is regarded as only a phase of learning and learning in turn is only a part of the larger education of the pupil. The teacher is to guide and direct this larger growth of the pupil. She must look upon her work from a truer and broader standpoint. Others must regard her and judge her as engaged in a more comprehensive work.

The truest and best view of the teacher is to consider her as being what she is—the leader of a social group. The pupils that gather into the class, because of their very nature, form a real group. By nature and training they communicate with one another, they have common experiences, common habits, common feelings, common ideas, common ideals. In order to live and work together such a group must work through a leader. The teacher, because of her age, experience, prestige and authority assumes the leadership. If she is a poor or weak teacher, sometimes an aggressive pupil takes temporarily the leadership from her. Sometimes the good teacher places leadership for the time being and for certain purposes in the hands of one or another of the pupils. But every school room has a teacher whose function is to lead the group.

C. THE COURSE OF STUDY

The pupils and the teacher are an organized group under teacher leadership. But their work is cut out for them, so to speak. They have certain subjects to study. Often the studies are presented in text books adopted by the school authorities. The time given to each subject a week is often prescribed. Then the subjects are graded to fit the school year and the average age of the children in the grade. All that is prescribed for the children to study in the grades of the school constitutes the course of study, or curriculum of the school. The course of study in a single subject is whatever of that subject is studied in the different years of the school.

Needless to say, the experience of the teachers in teaching and the pupils in learning has led to a pretty careful selection and adaptation of subject matter to fit the maturity of the pupils. Custom, habit, tradition has a great deal to do with deciding what shall be in the course of study. In general, it is easy to say that the schools teach what the pupils can best learn in the school and what will be most useful to them when they leave school. As a matter of fact, the principle is not easy to apply. Material is frequently taught in school after it has ceased to be of use to the pupil. Other subjects that are new but important are introduced into the crowded course of study only with difficulty after long effort. More important for the present purpose is to recognize that the real course of study is not found in the text books, nor in the outline prescribed by the school authorities. These seem but to suggest or symbolize the real course of study.

The course of study is what the pupils and teacher do together in the school room. For the pupils, it is the experiences of the school with all that implies. For the teacher, it is the experiences that she makes possible to the pupils through organization, selection, and presentation of materials, books, activities, and enterprises. What she considers to be teaching will determine largely whether the course of study shall mean to the pupils a limited subject matter slavishly memorized and mechanically recited, or a large, rich, and developing experience which the teacher enables the school-room group with her assistance to acquire, interpret, and control.

III. THE PROBLEM-PROJECT METHOD

By method is meant the way of doing something. Every art and practice develops its method. To have method means to have a purpose to accomplish and a way of accomplishing it that is economical of time and effort and, therefore, easy as compared with the way of the beginner and unskilled. A new method of teaching and learning is a new way of doing these things. The problem-project method of teaching is new in its emphasis and its conscious procedure. It is not new in many of its elements. All good teaching has always had something of the new method in it. To understand the method, it is necessary to know its origin and to be able to appreciate its scientific and practical foundations. Once these are firmly grasped, the method itself is readily understood and applied.

Various attempts have been made to define the project. All these attempts agree in one fundamental thing, that a project is an activity carried on with a purpose. Some have defined the project, therefore, as a purposeful activity. Others, while making purpose fundamental and necessary, maintain that the activity must be carried on in its natural setting. Just what setting is natural is not clearly brought out. So far as this emphasis on the natural setting of a problem tends to call attention to the fact that the work of the school room is often very artificial, it is well that it be made. If, however, the demand for a natural setting is to lead to a slavish imitation or reproduction of conditions outside of school in order to be natural, the danger is great that projects may become as artificial as the forms of teaching they are supposed to displace. It would seem safe, at any rate, to assume as fundamental to the idea of a project that it is an activity carried on with a purpose. To act with a purpose is to think. Thinking is problem-solving. To teach by projects is to create conditions under which pupils are led to attempt the solution of problems requiring them to investigate, organize, and test their own conclusions.

Difference Between Problem and Project

Before turning to the more detailed consideration of the subject, let us first clear up the difference between the words problem and project. So far as the words themselves are concerned they are really synonyms. Problem is a Greek word meaning something set before one to deal with. Project is a Latin word that is a very accurate translation of the Greek word problem. Both words have been brought into English and, as is natural, have acquired each its own peculiar shade of meaning. Problem is the word used more frequently in theoretical or scientific discussions. Project seems to belong rather to practical affairs.

In schools, for instance, the word problem has its peculiar use in mathematics, in the laboratory sciences, in the arts. Project is a newer term and came into the schools through agriculture, household arts, and the industrial arts. It has been suggested that problem is the word to use for the intellectual part of the activity while project is the term to be used in describing an activity that ends in some material outward result, like the making of a dress, a chair and the like. No amount of analysis or argument will finally decide which term is to be the common school term, nor just what distinction will be made between them, if both are retained. Usage alone will decide.

It is enough at the present to hold in mind the following: (1) Problem and Project are alike in that they both presuppose purposive activity, or thinking. (2) When we are discussing how we think in order to criticize our thinking, the word problem is the one we naturally use. (3) When we wish to decide the total undertaking in school practice, usage seems to tend to prefer the word project. (4) Every project has a problem within it which makes it what it is. In harmony with these points, this whole discussion is called the Problem-Project Method. This is deliberately done in order to show their fundamental identity. When we shall have occasion to discuss, think, we shall use the term problem almost exclusively, because it is the usual word. Later when examples are given of problem-project teaching in English, geography, history, and the other school subjects, the term project will be used because it is the more common.

A. INDIVIDUAL THINKING

It has already been stated that a person is individual and social at the same time. Thinking is an individual activity, as we all know. We do our own thinking. Nevertheless, we think with others. What they think helps us in our thinking. Often we have to think with others in order that we may act with them. It is a strange fact that most of the descriptions of thinking found in books on education, seem to ignore the extent to which our thinking is social, that is, carried on in coöperation with others. But it is necessary to understand individual thinking before we can understand social or group thinking. Let us turn then to a description of thinking.

The word thinking has a broad and general meaning and a narrow and scientific meaning. In the first sense, the word covers almost any activity of the mind. If we say that we are not thinking, we may mean that we are preoccupied, careless, dreaming, or that we are actually thinking of something else. In this loose sense, thinking may be used as equivalent to remembering, recalling, imagining, or any other mental function. In the narrow sense of the term, by thinking we mean reflecting, reasoning. Now the modern students of the mind in trying to tell how the mind works are influenced by the methods of scientific students in other fields.

Modern science asks two great questions in the presence of any phenomenon: (1) Under what conditions does it arise? (2) How does it go on? This is particularly true of the sciences dealing with living things. Formerly great emphasis was laid on the structure of plants and animals, the shapes, parts, organs were studied, described, compared. Nowadays, the great question always in the mind of the student is, What does the plant or animal do? Under what conditions does it do this or that? How does it do it? In a word, modern science studies function first, and structure second and as an instrument or tool with which the function is performed. The modern botanist asks first how the plant feeds itself, reproduces itself and considers roots, leaves, flowers, seeds as means. The modern zoölogist asks how animals move, feed, reproduce, and considers the parts and organs as means.

How Thinking Takes Place

This method of study that begins with function in order to understand structure has passed over into the sciences that deal with man, such as sociology, psychology, education, economics, politics. In psychology, in particular, the great question is not as to the structure of the mind, but as to its functions. The fundamental position of modern psychology and consequently of education is that sensation, perception, memory, imagination, reasoning are functions of the mind. To explain these functions is to answer the two questions mentioned above, under what conditions does the mind do these things, and how does the mind carry on these functions.

Now this is just what has happened with regard to thinking. Students of logic and psychology, the two sciences that deal with thinking, have answered these two questions. The reply to the first question, under what conditions does thinking take place, is this. Thinking takes place in the presence of a problem. We are confronted by a problem when we cannot go ahead, when we are in doubt as to what to do next. Put in another way, when we find ourselves in a situation where our habits no longer carry us on, we are forced to stop and think. Such a situation is sometimes called a problematic situation. Just here it might be said that the problem may be one that is chiefly mental, as for instance, how to answer a question in an intelligence test, or how to calculate the interest on a sum of money for a given time, or the problem may have a material side, how to get across a swollen stream, how to build a garage, how to make a dress, how to make a radio-telephone. This is why it was said above that at bottom, problem and project are essentially the same.

How Thinking Goes On

Having decided that thinking takes place in the presence of a problem, the second question arises, how does thinking go on. What do we do when we think? The answer to this question has been worked out in detail in a book by John Dewey entitled, 'How We Think'. Dewey's account of the process of thinking is the basis on which the theory of the problem-project rests. There are five phases of the thinking process that can be discriminated and that are important to observe if we wish to think critically and successfully. The phases might well be called steps, because they have a certain natural order in time. But at best, thinking cannot be reduced to a mechanical system that can be rigidly followed out to a desired result. In proceeding, therefore, to name these five phases, or steps in thinking, let it be noted that they are not actually separate and distinct acts, each of which is or must be completed before the next is entered on. Above all, these steps should not be reduced to a hard and fast formula of procedure in teaching or directing the work of children. They are, however, the actual steps taken in the solution of problems in the world of science, industry, and practical life. As such they can and should be recognized and used as a means of organizing one's procedure in individual and group work. These steps in thinking are: **Experience; Problem; Data; Solution; Application or Test.**

Steps in Thinking

1. EXPERIENCE. It has already been stated that the first great question that is asked about thinking is, under what conditions does thinking arise; and that the answer is, thinking arises in the presence of a problem. Accepting this answer to be correct, we can push the inquiry back one further step and ask, where does the problem come from? The answer is very simple, it arises within our experience. This is a very important fact to be held in mind. Real thinking can take place only in a real situation. We can repeat the outward form of others' thinking without thinking ourselves. To do so is to imitate others, to reproduce the acts of others. Such repetition or reproduction may force us to memorize the language of others' thoughts. This we may do with great accuracy and detail. But after all we are not thinking thereby, but merely recalling or reciting.

Thinking is like swimming. It is an activity that presupposes a particular kind of environment. We may take swimming lessons of a good instructor who may teach us certain movements of our arms and legs. We may learn to make these movements in a definite order according to definite count. But at last there comes the time when we enter the water and attempt to keep our bodies afloat and to make progress in the water. Then and then only do we swim. We do not need to be told whether we actually succeed in swimming or not. The position and movement of the body, the feel and resistance of the water, the pull and thrust of the arms and legs against the soft and yielding water, the final sense of floating under our own propulsion comes as a revelation that we have succeeded. We can swim. So we think and learn to think.

New Experiences Develop Thinking Power

We must have experience of a sort to make us think. There is no difficulty about our having to and learning to think outside of school. Life in the home, on the playground, in business provides us with experiences that are full of problems. We solve those problems the best we can. We learn from others what they have to offer, we try, try again, we recall all that we have experienced before, we imagine some way out of our difficulty, and we persist until we succeed or abandon our purpose. The whole process is taken for granted, is very real, and is a welcome challenge to our whole nature. The whole point is that life itself is just one continuous developing experience full of problems that are real to us and that demand solution from us, and that provoke us into the forming of purposes and plans which we use all our resources to carry out to a successful issue. We begin to think in a simple way very early in life, just as we taste and feel, remember, imagine, and the like. We think before we know how to think, if by knowing how we mean that we can give an acceptable scientific account of our procedure.

We all know how important new experiences are to make us grow in power to think. New playmates create a social situation that presents problems of adjustment. We have to learn how to get along with others. If we are born in the city, a transfer to the life of a farm overwhelms us with problems. New activities, strange animals, processes of preparation and cultivation of the soil, of planting and harvesting, new tools, the driving and care of horses, the feeding and milking of cows, all the life of the farm constitutes a new world of new problems which arouse our interests and direct and develop our efforts.

If we go to work in the city in a factory or a business house a very similar thing occurs. We are brought into contact with new activities, with new furniture, utensils, machinery. We see new things made and have our part to play in the making of them. We find that we are awkward and unskilled. We do not even know the names of things and what they are for. The new experiences make us think. We grow in the new situation. We realize that we are undergoing change and becoming different. So also with travel. A new physical environment, different scenery, strange costumes and speech, new pursuits and processes, all force us into new ways of thinking. And so the law holds good—new experiences, new problems, new thoughts. Right at this point it is important to recognize a distinction of the greatest significance for education and teaching. This distinction is between direct and indirect experience.

Direct and Indirect Experience

Direct experience is experience of a thing or situation as present. Indirect experience is experience of a thing or situation as represented or communicated by others. Direct experience is our own and we can tell others about it. Indirect experience is borrowed from others. A great many things might be said about these two kinds of experience, if it were important to attempt a complete treatment of them. The vital thing is to have the distinction once clearly in mind. Further elaboration of it will be easily made by everyone.

Direct experience is the necessary foundation of all indirect experience. Indirect experience is built on our common direct experiences. Direct experience has a reality, a degree of intensity, that it is difficult to secure in indirect experience. To be told about a thing is interesting and valuable, but it is not seeing it for oneself. The more we read about the Grand Canyon or Niagara Falls, the more pictures we see of them, the more anxious we are to see them. And when we do finally see them, they are strangely familiar and at the same time absolutely new. We have no doubt at all that they are seen for the first time. On the other hand, if we travel much and become familiar with cities and costumes we become increasingly able to form a picture of a city that we intend to visit so that when we are actually present in it we may say to ourselves that it is just what we expected to see.

What is thus true of travel, holds good in science, industry, commerce, and the professions. A physicist in America reads of an experiment carried on in a laboratory in Europe. He has enough direct experience in this subject so that he can understand a written account of the experiment. He goes about setting up the apparatus in accordance with the description and as a result gets a new, direct experience. A manufacturer reads of a new process of making steel, a new way of packing goods for shipment, a new way of organizing his business, and on the basis of this borrowed experience, he proceeds to get a new direct experience. A surgeon reads in the journal of his profession of a new method of operating and changes his procedure in like cases.

Mingled Effects of Experience

In the actual conduct of our lives, direct and indirect experience play a varying part. One might hasten to the conclusion that indirect experience, being gathered from others and thus less real, would have less influence on our conduct. But this is not always the case. It is what we do not see, do not know, have not yet undergone, that often has the greatest hold on us. This is why we are so often the sufferers from fear and worry. We see others in poverty and we begin ourselves to have the feelings of the poor, although we are well supplied with all the necessities of life. We read of people perishing on the sea and we are afraid to take a ship to Europe. We read of a bank failure and we hide our money in a stocking. The partly known is effective just because it is but partly known.

Our experience then is a strange medley of the direct and indirect. Some things we know and others we know about. But we cannot stop with this distinction. We must know just what function these two forms of experience play in our lives. Direct experience is founded by the limitations of space and time. It is as wide as our movements permit it to be and as continued as our life. If we live in a narrow spatial environment, travel little or none, and are in a simple primitive community, we gain a very intensive experience within these limits. But we remain local and provincial in our ideas and practices. If on the other hand we travel much and observe carefully, our mind and our conduct are enlarged and liberated.

Were we to be restricted to what we can directly experience, even if we did travel, we should still be narrow and ignorant, were we not able to learn from others. For the real explanation of what we saw would be withheld from us.

Beautiful buildings, railroads, steamships, telephones, monuments, business blocks, social customs, business methods, law courts, churches, schools, all have a history that must be learned from someone else, if they are to be understood and valued aright. The result is that while we do inevitably have an inner circle of direct experiences in time and space, it becomes increasingly difficult for us to be intelligent and wise within that circle unless we can draw on indirect, borrowed, communicated experience for explanation and enlargement of our direct experience.

In primitive times when men lived in separate tribes, it was easier to live a complete life of direct experience. Today the world is all of one piece. Clothing, machinery, foodstuffs, luxuries, objects of art are sent from one part of the world to another. We communicate with one another across the continent and over and under the seas. Nobody can understand his own little home world without taking into account the whole world of today and of yesterday. So our experience, to be rich and full and under our control, must be an intermingling of direct and indirect experiences.

A Necessary Relationship

But these two forms or kinds of experience nave a relationship one to the other that is vital and fundamental. Indirect experience can be communicated only when the elements of such experience are already in our possession as direct experience. If one had no experience at all of hot weather, luxuriant vegetation, tropical fruits, strange animals, it would be difficult to build up in his mind an idea of life in the tropical countries of South America. If one had no experience at all with machines, it would be difficult for him to profit by a careful description of the mechanism of an automobile.

It is a fundamental fact, therefore, in life, and it should be a fundamental principle in educational procedure, that a rich fund of direct experience is necessary to enable one to appropriate and use the inexhaustible treasure of indirect experience available in books, magazines, newspapers, and pictures. We can only learn what we in some part already know. On the other hand, indirect experience is of value to us only as it helps us to understand and control our own direct experience. Much that happens to us has its origin and cause outside our own range in space and time. The tropical fruits that we eat, the machinery that we use, the markets for the goods we help to make, the coal that we burn, the clothes that we wear, the music that delights us, the government that protects us, the sciences and literature that guide our intelligence and sustain our spirits, all presuppose a world beyond our reach in time and space. This outside world creates, sustains, and interprets our own narrow world. Thus these two forms of experience are not separate and independent, but are fused together in the very processes by which we build up our world of facts, ideas, purposes, values, and efforts.

Important Point in Education

The great problem of education as the science and art of controlling the growth of the young is to organize the life of the school so that indirect or communicated experiences may really unite and fuse with direct experiences. It is a problem of making the school simulate life in this fundamental respect. The out-of-school life of children may be too narrow and limited, or it may be too confused and distracting to favor a broad and continuing growth. But it has the advantage of being real, direct in its appeal, and full of problems. The school, by its very nature, has the disadvantage of withdrawing the children from the rich life of the society which produces them.

For many years it was the accepted theory and practice of the school that its chief business was to give children the means of communication and communicated experience. The assumption was that once the experience in the symbolic form suited to adults was reasonably well fixed in the minds of the children, the school's work was done. The indirect experience was supposed to remain in reserve, ready for use at some time when it would be needed. It would be untrue and unfair to assert that the school did not do better than it planned and thought. Sometimes it did better and sometimes it did worse. The trouble was that on its own theory it could only succeed by accident. Where the work of the school was carried on in connection with an interesting and real life outside, the children achieved the connection between their school work and the work outside. If they failed to do so, no great harm came of it.

The problem of the modern school is much more complicated and difficult. Life in and out of school is much more complex and the task of the school has been greatly increased in scope and extended in time. It must have a theory and practice that makes success possible. The application of what has been said to the conduct of the school, to education, to teaching may be summarized as follows:

a. Thinking is problem-solving.

b. Problems arise within experience.

c. To give children problems means to find problems that are within their experience, or to provide them the experience out of which real problems arise. This means that the teacher must treat the out-of-school and the in-the-school life of the children as one continuous whole.

d. Indirect experience must be given children to help them solve problems growing out of their direct experiences.

e. The problem-project method aims to teach children to think by dealing with problems found within or introduced into their experiences.

2. PROBLEM. It seems unnecessary to attempt a definition of a problem. It is clearly something to be wrestled with, to be attacked, to be worked out. In ordinary life we seem to run into problems, we are confronted by them. We do not hunt them out, they meet us on the way. In terms of consciousness, they represent suspended action; we can't go on until we do something and we do not know what to do. For this reason, it is often said that problems arise when habits no longer enable us to deal successfully with our environment. Where established habits function satisfactorily, no problem arises. It is easy to see, then, that problems arise either from change within ourselves, or in the world outside ourselves with which we have to cope. There is no difficulty, then, in seeing where problems come from. We change, we grow; new desires, new talents, new capacities, new responsibilities are always entering into our lives. Even our successes and achievements raise us to new levels from which we can see new difficulties and new opportunities arising before us.

Confusion is likely to arise in the discussion of the problem due to the use of the term to cover two distinct aspects of the problem situation. These two phases are **the problem presented,** and **the problem formulated.** A word or two may serve to make the distinction clear and assist in the application to the teaching process.

The Problem Presented

When we say that thinking arises in the presence of a problem, we are concerned to make clear the characteristic conditions under which all thinking takes place. We then proceed to indicate, as above, that such a problem implies change within us, or the environment, or both, as the result of which we are made conscious that we cannot act as we habitually do, that our desires are thwarted, and that we must do something about it. In the discussion of the problem-project method, we should be careful to recognize that this use of the term problem is the broad one, and that to it the whole thinking process should be related. In this situation, we are led to define to ourselves what precisely we want to do under the circumstances. This effort at definition leads us to—

The Problem Formulated

Of course this effort at definition or formulation is not a matter of a single act. All through the steps of the thought process that we are attempting to describe, there continues to be re-definition and re-formulation as we know more what we can or cannot do. The point is that at least a tentative definition or formulation does take place. This step corresponds to purpose forming, choosing of an aim, selecting an objective. When we say that thinking is purposeful activity, we are describing the whole process by using a term fitting this stage of its evolution. There is no synonym for the first use of the problem as just described, i.e., the problem presented. The synonyms for the problem presented are purpose, aim, end, objective, project. Such a problem, purpose, or the like, is simply a foreseen result, something that we want to bring to pass.

For teaching, the vital consideration again is that the problem presented must be within the experience of the children and that the problem formulated must in some real way appear to the children a desirable purpose, aim, end, objective, or project. It is at this point that educational procedure should profit by a very fundamental distinction. A problem to provoke thinking must be the child's own problem. That means that it must be related to his own experience. It must grow out of his own desires and interests. It must fit his situation. But just what does this mean? When is a problem a child's problem? The answer is, when he adopts it as his own.

The teacher creates the conditions under which the children live in the school. These conditions are not merely the physical environment of desk, laboratory, books, and the like. Nor do they consist merely of the social organization and activities of the classroom group. The teacher is a part of the environment for the children, as truly as the mother is a part of the environment of the home, or the office manager of the office. The teacher not only creates but helps to interpret the school environment. The teacher's function is twofold: first, to create a situation affording real experience involving real problems for the children; and second, to help by suggestion to define and formulate the problem, purpose, aim, end, objective, project, so that the children will adopt it as theirs, identify themselves with it. The danger here is that the problem or purpose will be dictated to, or imposed on, the children.

The Value of Originality

This is the fine art of teaching, to suggest problems and purposes in such a way that the children choose them because of their inherent relation to their own lives. In order that children may work at their own problems, it has sometimes been assumed that the children themselves must discover and formulate, must really originate, the problems themselves. Children outside of school and adults in social life originate very few of their own problems. They are set for them by their leaders in the coöperative enterprises in which they are engaged. They are suggested to them by what others say and do. No matter where a problem or a purpose comes from, it is mine when I make it mine. To leave it to children unaided to invent and originate profitable problems in school is as unnatural and foolish as it is in out-of-school life. If the school life is continuous with out-of-school life, if it enlarges and interprets the children's experiences, the children and teacher together will recognize and define the problems to be solved, the purposes to be achieved.

3. DATA. The third phase or step of the thinking process is to survey the situation to find what resources are at hand for solving the problem. Having defined to some degree what we want to do, we look about us to discover what we have to do it with. The Latin word *data*, which means "the given," is used to indicate facts, evidence, material, with which one begins the solution of a problem. That is the meaning in which it is used in this discussion. "Data" means anything or everything that is available for solving a problem. This meaning of the term permits a very wide application. Data may be ideas, facts, tools, stones, native powers, acquired skills, reputation, prestige, money, credit, anything and everything in human life. Data, however, are always such for a particular problem. One could never tell what to regard as data, save as one kept in mind what problem he was seeking to solve, what purpose, aim, end, objective, project, he was trying to carry out.

This is just the significance of this phase, or step in thinking. One uses his problem, or purpose, as the searchlight, as it were, with which he surveys his whole experience, past and present, to learn what he has available to use in solving his problem. The drowning man clutches at a straw because that is all he can find. So in practical life we mend clothing with nails or pins when buttons and needle and thread are not at hand. The simple processes of problem-solving in the home, on the farm, in the workshop are the same in kind as those of the scientific laboratory. The latter are more difficult, perhaps; require more refined thinking and analysis, but they differ only in degree. This explains why the expert in the field is the one who makes the discoveries and takes the new steps. He has more data with which to work. The application of all this to teaching in the school is manifest. The data which are available are not known even to adults, when they first start to solve a problem. They must "look it up," as the saying goes. Where does one look for data in every-day life? At home, one asks parents and elders. In the world of business, it is the superior, the more experienced to whom one turns.

But above all, there is the world of books. One of the greatest services that can be rendered a child as he goes through school is to teach him that there is a whole world of knowledge already organized for his use in books and libraries. But the act of hunting for the data, the "looking it up" is the educative experience. What a pupil learns in any case might be given him outright by his teacher. But the knowledge thus gained would have only the value of the fact itself. To "look it up" oneself is to get the notion that problems are soluble and to develop the initiative, persistence, and sense of personal responsibility which result in independence and self-reliance. The problem-project method of teaching, if carried on in the genuine spirit of research and inquiry, will produce a type of educated man and woman that will face forward, will think their own way to the solution of problems, and will be above the influence of mere habit or custom.

4. SOLUTION. The fourth phase, or step, in problem solving is the setting up of a probable or possible solution. This is, of course, the crucial activity. If the problem is fairly defined, and the data are surveyed to see what can be utilized in the solution, the solution itself is carefully thought out. To think of a solution is an act of the imagination. One has to hold the whole situation before the mind's eye. Here is the problem to be solved, here is what one has to work with, the data or means, here is what one can do with the data to work out the problem.

Here again emphasis must be laid on the fact that these steps are not separate in time, nor can they be separated in thinking. My problem must be clearly before me if I am to recognize what among my innumerable resources, inner and outer, are possible data for this particular problem. At the same time, both problem and data must be held before me as I try to think out the solution. With the data or means at hand, only such and such a solution is possible. The solution that is finally hit upon is not made out of nothing. One thinks of similar situations in one's past experience, one recalls or learns how others have gone about solving similar problems. Great inventive and creative minds seem to have unusual power of working out solutions that often seem very simple once they have been worked out.

The educational significance of this phase of the thinking process is fundamental. Whatever the teacher does to provide experiences involving problems, to help detect, define, and choose the problem to be solved, to furnish and stimulate the search for data, the greatest skill will be required to suggest possible solutions, or part-solutions, without giving outright, the solution. The children should be permitted, led, urged, and helped to work out their own solutions. This is the very essence of thinking, it is thinking. The experience, the joy of doing this work for oneself is the best training in thinking and the best guarantee that one will continue to think for himself. Before leaving the discussion of this phase, or step, let us note that the synonyms for "solution" used in discussing thinking, or the problem-project, are two Greek words, "theory" and "hypothesis."

5. APPLICATION OR TEST. The fifth phase or step in the solution of problems in thinking as a phase of experience is to put the solution, theory, hypothesis to a test. So far the solution is one only thought out. It must now be acted out. To test a solution is not to apply some external means to it, as one tests acids by litmus paper, or starch by iodine. The test of a solution is to do what the proposed solution called upon you to do. Perhaps a better word would be to execute it, that is, carry it out. Your solution, theory, or hypothesis, always has essentially two parts. If I do this and this, then this and this will happen. To test, or apply, or execute the solution, you just do this and this. If what you thought would happen, does happen, your theory, solution, hypothesis is true, you have solved the problem. If what you thought does not happen, there is left for you only the return over the whole process again with the added knowledge gained by the whole experience. You define the problem anew, add or reject data, modify your solution or theory until you get one that will work out in practice.

B. SOCIAL THINKING

Thus far thinking has been treated as if it were an individual matter. The conditions under which an individual is led to think and the steps or phases of the thought-process have been named and described. At this point it should be emphasized that although an individual does his own thinking in the way set forth above, his thinking is not merely individual. The occasion of his thinking, the material, data, and results of his thinking are all affected by the activities of others. Life is all of a piece. Our activities, our purposes, our feelings, our desires are but phases of our coöperative enterprises with the world of people about us. In the home, at school, in the business world, in science, literature, and art, we are always dealing with a world that others have constructed and others are now maintaining. If we are going to carry on our own enterprises and solve our own problems, our thinking must constantly deal with what other people are thinking and doing. We must fit our plans into the plans of our parents, our teachers, our leaders.

Group Activity

The great outstanding fact about the life of people is that it goes on in groups. The family, the school, the church, the business organization, the city, the state, the nation are groups of people who commonly work together for certain purposes. Some of these groups are stable and persistent. Others are temporary. But whether the group be hastily organized or of long standing, the fact that makes it a group is that the people who form it have a common, a group or social mind. This means that they have common experiences, common ideas, common ideals, common customs, habits, feelings, desires, and purposes. These they get by living under common conditions. In order to act together as a group, they must have common purposes to carry out. They get these common purposes by the processes of communication, by language spoken or written, by the printed page in the form of books, magazines, and newspapers, by the telegraph, telephone, wireless, and radio, and by travel from one place to another.

A group may be as large as the existing means of communication permit it to be. The United States of America is a very large political group. It can act almost as one man, although it has one hundred twenty millions of people in it. It can do so because in the main the people use one language, read the same news and books, and because the material means of communication such as railroads, telegraph, telephone, and the like are so highly developed. This ability to act in coöperation to achieve a common purpose was demonstrated during the great World War. A group has been defined as a number of people acting under a common purpose. If we go back to our description of thinking, it is easy to see that group thinking, like individual thinking, is just purposeful activity on the part of a group. Purpose, then, is fundamental both in individual thinking and in group or social thinking.

The Socialized Recitation

The socialized recitation is one of the newer methods of conducting the work of teaching. The problem-project may be an individual project, or a group project. When it is a group project we have a socialized recitation. It would be simpler and better therefore to abandon the term socialized recitation and use the term group-project. But since the former term is in use, it is wise to recognize its real nature. The essential things to be observed in using this form of class-room procedure are **Group Purpose; Division of Labor; Group Test.**

1. GROUP PURPOSE. A socialized recitation is at bottom but a carefully planned and organized and executed group project. The essential thing about it, therefore, is to start with a group problem or purpose.

All that has been said about the source of the problem above applies here. The common problem, purpose, project may come naturally from the previous work of the group, may be suggested by one of the pupils, or by the teacher. The essential thing, again, is that the purpose be not dictated to the group by the teacher, but should be adopted by the pupils as their own. This latter result can be brought about in various ways, by formal vote, by consensus of opinion, or in any way that a group would be led to make up and express its mind. From the standpoint of effective teaching, the prime requisite is that every member of the group should be brought to understand clearly what the purpose, problem, project is. Since it is a group problem to be solved, the next step to be taken is to work out carefully a division of labor.

2. DIVISION OF LABOR. The group project, problem, purpose can be accomplished only as all the members share in the work. It is just this sharing that makes the work educative. The members of the group, under the suggestion of the teachers, should themselves divide up the work. So far as possible each one should be allowed to undertake the part he wishes to have in the enterprise. The interest of the whole group as well as of each member depends on the skill with which this division of labor is accomplished. Each member now has an opportunity to exercise initiative in finding data that are presented to the class and in suggesting solution to the problem. The group then assembles, criticizes, and evaluates the contributions in the form of data and solution presented by each member. Here lies the opportunity for oral and written report, argument, criticism, and suggestion. This whole process of coöperation should end in a final group test.

3. GROUP TEST. Just as the group problem must be carefully set forth and recognized by each member of the group, and as each member must have his own share in seeking a solution of the problem, so the whole group effort must end in a definite approval and appreciation of the result reached by the whole group. A definite time and program should be arranged for this final test. The group work should find unified expression. This may take the form of a public program, an exhibition, the formal adoption of a written conclusion, the printing of such conclusion, in any and every way in which a school group may find it possible to bring to its own consciousness that as a group it has reached a definite result. A comparison of the procedure in individual thinking, or problem solving, will make it clear that the socialized recitation is but the formal carrying out of a group project in the course of which each member of the group works out his own individual project.

The Problem Method in Geography

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GEOGRAPHY has passed through several stages during its growth and development in the United States. During the early part of the past century, many of the geography textbooks were little more than "Geographic Catechisms." Gradually description crept in and geography came to be known as the study of the earth and its people. As long as this meaning was held, geography consisted of a mass of material, much of which was unrelated. It consisted chiefly of the location of places and the memorizing of facts. Fact after fact was presented in almost the same way. Children were supposed to be walking encyclopedias and they learned to locate places, many of which they would never have any occasion to use after leaving school. Memory work was encouraged because it was thought that children had better memories than judgments, and it would be a waste of time to have them think out solutions.

The World War and Geography

A few years before the World War, mention was being made of the "new geography" and the "Why" element was showing on the horizon. Our relations with foreign countries had been growing stronger each year, but how strong no one realized until the World War broke forth. Then we awakened to the realization that the United States is connected rather closely with the rest of the world. People began to look for reasons why the United States, which is 3000 miles from Europe, could be affected so much by the war. Geography gave the answer, for it was learned that the United States owes its importance not only to its energetic people, but to such geographic factors as climate, physical features, resources, and location. Further study showed that nations are related so to one another in trade and commerce that when the arteries of commerce are closed or a serious calamity happens in one or more countries, the other countries of the world are affected in a greater or less degree.

Today, geographers are looking over a new horizon, for it is recognized that geography treats of man in relation to his physical environment, not only man in the United States, but in all parts of the world. Geography shows that human beings similar to us inhabit the earth. It shows that people all over the world, whether they are in the hot moist regions of Africa or on the prairies of Illinois, have some problems in common. By knowing that the regions of the earth may differ from one another in respect to climate, physical features, resources, and location, it is understood readily why people living in such regions may have various aims and ambitions. Thus wars will tend to disappear and commerce will flow uninterruptedly.

Aims in Teaching Geography

Through education, the individual learns how to adapt himself to his various environments so that he may become a better social being. Geography, in treating of man in relation to his physical environment, occupies an important position in education: Some of the common aims which every teacher of geography should have are:

(1) To cause the pupils to become citizens of the world by giving them a sympathetic understanding of the peoples of the world.

(2) To show how geography affects the problems of life, why man works, how he works, and where he works.

(3) To show how man depends upon the earth for a living and to show some of the economic problems which he faces.

(4) To give the pupils a knowledge of the location of the chief places of the world such as rivers, lakes, oceans, cities, and mountains.

(5) To show how the natural resources may be used to the best advantage, to predict, whenever possible, the future possibilities of a region.

(6) To teach the pupils how to solve problems and how to use their knowledge in new situations so that they may work independently in later years.

(7) To teach the pupils how and where to find materials and information, how to use such helps as books, pictures, maps, graphs, and museum materials.

(8) To teach the pupils to have an interest in everyday affairs, to enjoy the beauties of nature and to spend their leisure time in profitable ways.

(9) To apply geographic principles so that the pupils may understand the growth of leading cities, the development of important industries, and the interdependence of nations.

(10) To lay a foundation for the study of geography in later years and for making an honest living.

Problem Solving Versus Memory Work

In order to fulfill the aims of geography, the task of the teacher is to see that the material is presented in the best way. Various kinds of lessons have been used, but the one that seems to have the most promise is the problem method. A problem in geography is a unit of activity with a well defined worth-while objective and it is carried to completion usually by a series of minor problems. (This definition is given sometimes for a project, but in this article we make no attempt to distinguish any difference between a project and a problem.) By using the problem method, pure memory work gives place to reflective thinking and the pupils learn to reason for themselves. However, a good memory is not to be disregarded, because in reasoning past events must be recalled. Hence a teacher or a pupil should not think that nothing should be remembered. The fact is that in reflective thinking, where the pupils reason out things for themselves, much will be remembered and will be ready for use in solving other problems.

Problem Solving in Regional Geography

Since the problem method is a unit of work, it well is adapted to regional geography. Until recently, political geography was the chief kind of geography taught in our public schools. Each state or country was taken up separately in about the same way, with very little regard to any other state or country. The result was that geography was taught usually by a standard outline which included location, area, climate, surface, soil, drainage, natural resources, plant and animal life, and human life. When the last topic was finished in the outline, the pupil had an idea that he had done a very thorough piece of work.

Today, regional geography has largely taken the place of political geography. States and countries still are studied, but in relation to the region to which they belong. A geographic region may be said to have (1) essential unity in physical environment, (2) essential unity in human response and human activity, and (3) essential unity in density of population. Whether a large number of geographic regions of the earth will be made depends largely upon the age of the pupils. In the grades, the number of geographic regions for a continent, such as North America, will be small, while in a college the number should be larger. In both cases the students are studying regional geography, but because the college student is more advanced he will be able to make finer distinctions.

Rules for Determining a Problem

If a geography teacher is going to use the problem method, he must know how to determine suitable problems. A great many problems arise in the classroom, just as in life, that need not be answered. Since there is only a limited amount of time for geography, the teacher must see that only the best problems are taken to be solved by the pupils.

Some of the rules which a teacher may apply in deciding whether the problem is appropriate are: (1) Is the problem of enough importance for the class to take? Will it bring out minor problems and projects which will interest the pupils and will it develop the pupils along the right lines of thought? Will the conclusions reached be worth while and may they be used in solving other problems? (2) Is the problem adapted to the pupils or is it too difficult or too easy? (3) Is this the grade in which the problem should be taken? (4) Is there plenty of material which the pupils may obtain in solving the problem? Occasionally worth-while problems may arise which will have to be cast aside on account of lack of material. (5) Is the problem stated so that it will bring out what is intended? (6) Is the problem one which may be completed in a reasonable amount of time? Do not teach the pupils to become careless by leaving things undone. (7) Is the problem one which will give the pupils a more sympathetic feeling for all people and thus show the interdependence of all nations? Does it fulfill the aims of geography?

Raising the Problem

A geographic problem may be raised in a number of ways just so long as the pupils feel that it is their problem. In some cases the teacher may assign the problem. If the pupils immediately enter into it, this is sufficient. Sometimes the teacher assigns the problem and then discusses with the pupils certain material which shows the need of the problem. At other times, the pupils and the teacher discuss certain topics, and a problem arises and is stated by the pupils in place of its being stated by the teacher. Again, the pupils in their outside reading and activity may find a problem which they want to answer. When they come to the geography class they may be so enthusiastic over their problem that the whole class may wish to solve it.

Current events will sometimes furnish the problem. Newspapers and magazines publish much geographic material which may be used in the classroom. By using current topics, the pupils are led to see that the life in the schoolroom is related to the life outside the school and that they are solving real problems. For example, a class had finished a problem and the teacher was thinking about what problem to take up next. However, the children found the solution. When the class began the next day, one of the pupils had a clipping which told about a meeting being held which discussed the proposed Great Lakes-St. Lawrence Waterway. The clipping was read, and since the pupils lived in the territory near the lakes, they became much interested. Numerous questions were asked and soon the problem was raised: "Of what benefit to the United States and Canada would be the Great Lakes-St. Lawrence Waterway?" Since the problem covered work which the pupils were supposed to have during the year, and since it was a live subject which will be before the American people for some time, the teacher gave his approval and the class spent several profitable weeks on its solution.

Stating the Problem

The problem may be stated in a number of ways. It may be (**1**) **a question,** as, "What has enabled Chicago to become the second largest city in the United States?"; (**2**) **a debate,** as, "Resolved that the United States should develop its waterways"; (**3**) **a scoring lesson,** as, "To find out whether Canada or Mexico has the better opportunity for future development"; and (**4**) **a declarative statement,** as, "Why China must become an important country" or "To show why the trade of New York is greater than that of San Francisco."

Likewise the problems may be selected which will account for past conditions such as: "Why did most of the American settlers stay near the Atlantic coast until after the Revolutionary War?", or "Why did civilization develop at an early date in the valleys of the Tigris and Euphrates rivers?" The problems may treat of present day conditions such as, "Since the area of New England is so small, why is it such an important manufacturing region?", or "Account for the sparse population in the Amazon valley." The problems may deal with future possibilities such as, "Will the population of Chicago ever surpass that of New York?", or "Will the hot moist regions ever become densely settled?"

Work of the Teacher

After the problem has been selected by the pupils the work of the teacher only has begun. To be a first class teacher of geography, a teacher must have the true vision of geography. He must understand what he is teaching and he must make his work a part of himself. He must have the power of so leading the pupils that they will feel as if they are exactly seeing the things about which they speak. It is one thing to draw an outline or to make a rough sketch of a region, but it is another thing to feel as if the picture is real. In drawing a map of a region, the pupils should see in their imaginations the things which they would see if they were actually in the place represented by the map.

The teacher should know his subject thoroughly. He should know where references of various kinds may be found and he should be ready to meet all problems which may arise. All materials such as maps, museum material, pictures and graphs should be listed so that they may be turned to at a moment's notice. The teacher should know when to help, for sometimes a few well chosen words at the right time will do much in aiding a pupil.

When necessary, the teacher may aid the pupils in the following ways: (**1**) He should make sure that the problem is stated so that the pupils understand it. Then there will be no excuse of "I did not understand it." (**2**) The teacher should see that the problem is kept in mind. Pupils are human beings and their attention may be deflected from the problem. It may be written on the board and at times doubtful pupils may repeat aloud the problem. (**3**) The teacher may help the pupils in analyzing the problem. Past experiences should be recalled by the pupils and new material collected. All pupils should take part but it is not necessary that all should do the same work. Such projects as posters and maps may be made. Minor problems may arise and projects may be undertaken by the pupils. If desirable, an outline of the progress made day by day may be put on the board. A suggestion here and a word there, given by the teacher, may benefit some uncertain pupil at the right time. It is here that the supervised study lesson is used. With the pupils hard at work under the direct supervision of the teacher, much time is saved and the pupils learn correct habits of study. (**4**) The teacher should aid the pupils in coming to conclusions. All material should be weighed carefully before being accepted. A pupil should be led to see the value of constructive criticism and of having an open mind. Only after much reflective thinking should a pupil make up his mind on any important problem.

The Value of the Socialized Lesson

In solving geographic problems, the socialized lesson finds its great use. In a socialized lesson (**1**) the pupils do not do necessarily the same work. The class may be divided into groups and each group do independent work in solving some part of the problem. Each group reports to the class as a whole and when all the groups are through reporting, the pupils are able to make up their minds concerning the problem. Sometimes a pupil may be chairman and the teacher will take part only when necessary. (**2**) In a socialized lesson the pupils enter into the discussions in a democratic way. No one is permitted to monopolize the recitation or to do all of the work. It is here that the pupils are taught to respect the rights of others. Initiative, leadership, and self-dependence are developed. (**3**) In a socialized lesson all pupils may not do the same amount of work. Each pupil does as much as he is able to do and he is made to feel that what he does is worth while. (**4**) Socialization requires that a pupil should have the opportunity of asking questions and of raising problems. In the old time classroom, only the teacher asked questions and the pupils answered them. Today we think that it is good teaching if the pupils not only answer questions but also ask intelligent ones. Likewise many believe that problems and topics for discussion should originate with the pupils.

In order to illustrate and to make concrete what has been said, three problems are given.

EARLY GRADE PROBLEM

Learning to Tell Directions and to Read a Map: The teacher took her fourth grade beginning class to a small park near the school. In going to and from the park the pupils noticed in what direction they were going. They learned the names of the streets and in what directions they ran. Some of the homes of the pupils as well as other things of interest were pointed out and their directions noticed. On reaching the park, the pupils observed such things as the tennis courts, the playgrounds, the ball diamonds, the bathing pool for children, the building which contained the branch public library and the assembly hall, the shrubbery, the flowers, and the trees. While in the middle of the park they had a pointing game. Their attention also was directed to the sun and they noticed where it was.

When the children returned to the schoolroom, they were bubbling over with information and they wanted to show their journey on a piece of paper. For several days, the map idea grew. A large piece of white paper was put on the floor and the children traced their routes to and from the park. The schoolground and the park were drawn at the opposite ends. Names of some of the things which the children noticed were put on the map. Cross streets were put in. Since a few of the children lived on the streets represented on the map, they were permitted to mark the sites of their homes. At the north end of the map the word north was written, at the south end was written south, at the east side was written east and at the west side was written west. The teacher was careful to see that the words were written so that when the map was hung later on the wall, the words would be in the correct positions.

By this time the rest of the pupils wanted to draw maps showing where they lived and this paved the way for making a small map of the neighborhood. Each pupil was given the street on which he lived to put on the map and he located his own home. Sometimes several pupils had the same street because they lived on it. As the map grew, places near the school were located. Many pupils, not contented with a group map, made maps of their own.

The pupils put in practice what they had learned in the geography lessons which followed. Throughout the year, the pupils observed the sun at certain periods of the day and they soon began to associate directions with the position of the sun in the heavens.

SIXTH GRADE PROBLEM

Where Does Our Silk Come From? This class had been raising some silk worms for their nature study work. The pupils were very much interested in the silk worms until they began to spin their cocoons. Then their interest in the worms began to vanish and they became curious to know something about the silk which the worms were spinning. Some one suggested that it must take many worms to spin enough silk for a yard of cloth, many of the pupils began to question where so many worms could be found, and some one asked where the United States obtains its silk. Finally the pupils decided to take as their problem in geography, "Where does our silk come from?" Research work was on in earnest.

Learning Where Silk is Produced

Each of the pupils made a graph showing the amount of silk produced by the leading silk-producing countries which are Japan, China, France, and Italy, Then the problem arose why Japan and China produce more than two-thirds of the silk of the world. The pupils were put into two groups and one group took Japan and the other group took China. They found out that the mulberry tree does well in these countries due to a warm moist climate, and that at least two crops of leaves may be gathered annually. They learned that since only one-sixth of Japan is level enough for agriculture, mulberry trees are raised on the slopes of the mountains. They discovered that there is plenty of cheap labor, furnished chiefly by girls and women. Chinese and Japanese life and manners were discussed and the pupils brought out many things about climate, surface, transportation, resources, and homes.

After the groups got through reporting on Japan and China, they took up France and Italy. Among the minor problems developed were how Pasteur aided the silk industry in France and how France and Italy have a difficult time in competing with the cheap labor in Japan and China.

Other regions which produce silk were studied briefly.

The Discussion of Silk Manufacture

After seeing where the silk is produced, the pupils began to study what is done with it. Graphs were made showing the amount of silk imported by the United States from the chief silk producing countries. Several problems in arithmetic were solved. It was learned that the United States receives most of its silk by way of the Pacific Ocean from Japan and China. One boy brought in a newspaper clipping telling about a silk train going from Vancouver to New York with the right of way over all other trains. The reasons why most of our silk goods are manufactured in New York, New Jersey, Pennsylvania, and Connecticut were developed.

In a similar way, the pupils discussed silk manufacturing in Japan, China, France, Switzerland, Germany, Italy, and the United States. One of the children brought to class an article from a magazine about silk stockings being made from artificial silk, so a brief discussion was held on this topic.

Pictures, reference books, maps, and graphs were used throughout the discussions. During the study periods and the recitation periods the pupils had taken notes and written short compositions, so when the work was ended, they collected their papers in a logical manner and had a small pamphlet on silk. The pupils collected and arranged a silk exhibit of their own.

The last day was spent by the teacher and the pupils in seeing that they had the important points which had been developed in the solution of the problem well in mind. No problem should be left without a review of the important factors entering into its solution.

UPPER GRADE PROBLEM

Why Does the United States Produce Three-Fifths of the Cotton of the World and What is Done with It?

I. **Raising the Problem:** What are the common articles from which our clothing is made? Which is the most common? On a blank map of the world color the regions producing cotton. Make a graph showing the yield of the leading cotton producing countries.

II. **Problem Raised:** Why does the United States produce three-fifths of the cotton of the world and what is done with it?

III. **In the Solution of the Problem Many Minor Problems Arise:**

- A. **Where in the United States is cotton raised?**
  - a. On a blank map of the United States color all the regions producing cotton. Make the color darker in the areas producing the most cotton.
  - b. Make a graph showing the rank of the cotton states in the production of cotton.
- B. **Why is cotton the king of the South?**
  - a. Has the South a favorable climate for cotton? Notice that cotton does best where there are more than 200 frostless days. Frequent showers with warm weather while the cotton is growing, and a rather dry picking season are needed.
  - b. Has the South a favorable soil for cotton? On a soil map, notice the kinds of soil on which cotton seems to do the best. The black soil region of Texas, the alluvial region near the Mississippi River in Arkansas and Mississippi, and the limestone regions in the Carolinas, Georgia and Alabama should not be overlooked.
  - c. Has the South plenty of cheap labor? Here may be discussed the laborers, the prepara-

tion of the land, the planting of the seed, the cultivation of the cotton plant, the boll-weevil, the picking of the cotton, the ginning and baling.

C. In what other states is cotton raised?
  a. Southwest United States by irrigation.

D. What is done with the cotton seed and the stalk?
  a. Make a list of their uses and discuss the importance of each.

E. What is done with the baled cotton?
  a. Sent to markets and sold. On a blank map of the United States locate the cotton markets.
  b. A little less than one-half is exported to foreign countries. On the map showing the cotton markets show the cotton ports of the United States.
  c. The remainder of the cotton is used in the United States.

F. How does the length and quality of fibers raised in the United States compare with those raised in other regions?

G. Where is cotton manufactured in the United States?
  a. On a blank map of the United States locate the cotton mills.
  b. Make a graph showing the consumption of cotton by the ten leading states.
  c. New England Region. Reasons for its importance. Quality of goods manufactured.
  d. Southern States, especially along the eastern edge of the Appalachian Mountains. Reasons for manufacturing cotton goods. Quality of goods manufactured.

H. Where are cotton goods manufactured in foreign countries and how do these countries rank in quality of their goods?
  a. On the world map showing the cotton-producing regions, show the routes over which cotton is shipped in being sent to other countries. Locate the chief cotton ports.
  b. Why does the Liverpool-Manchester district rank so high in the manufacture of cotton goods?
  c. How important is the manufacture of cotton goods in France, Germany, Belgium, Italy, and other European countries?
  d. How do the countries of Asia and South America rank in the manufacture of cotton goods?

I. What is the future for cotton?
  a. What is the prospect of increasing the area given over to cotton in each continent?

IV. **A Review of the Problem of Cotton:** At certain places in the work, the pupils make brief reviews of what they have learned. On completing the problem, the teacher and pupils should make certain that the material is classified well in their minds.

V. **Remarks:** Throughout the study of the problem, the pupils use all available material. At favorable times the pupils show lantern slides, pictures, museum material, and any other material which may be of aid in solving the problem. Group work is used whenever it is desired by the pupils.

Relation to Other Subjects

In using the problem method, the relation which geography has to other subjects is developed. For example, the problems cited show that geography is related to history, spelling, English, literature, reading, arithmetic, nature study, and writing. In teaching geography the teacher should remember that while geography may help other subjects, it likewise may receive help from them. However, the business of the teacher is to develop the geographic viewpoint through the use of suitable geographic material.

The Project Method in English

ONCE upon a time in the dim past which is so frequently referred to as the Golden Age, schools did not teach English composition at all. One day some reformer discovered that the young people did not speak and write as perfectly as might be desired. The immediate effect of this discovery was to increase the emphasis upon English grammar, which it was hoped might prove corrective of the linguistic weaknesses. A thorough trial, however, convinced everyone that mere knowledge of the structure of the language and of the rules of syntax is not sufficient to prevent error, nor to bring about the formation of strong, clean-cut and expressive sentences.

Obviously grammar does not influence the larger matters of structure or of diction. To grammar rhetoric was added, and still the results in the speech and writing of the high-school and college graduate were difficult to see. The next experiment naturally was a very great increase in the amount of practice, especially in writing. The daily theme became an almost universal institution in both secondary schools and colleges throughout the country. It was frequently accompanied by much drill in the correction of mistakes in syntax and in the rewriting of incoherent and loosely constructed paragraphs. The pupils still not improving as rapidly as was desired, errors were drastically penalized in the grading. Even such heroic action failed to produce the desired improvement.

Thus teachers of English were quite prepared for some new method or procedure whereby they could really teach their pupils to express themselves correctly, easily, and forcefully. The field of English was rich soil well prepared for the educational doctrines of John Dewey, especially as these were interpreted by William H. Kilpatrick. The notion of experience as an educator is almost as old as the race, but only with Dewey did we finally become fully conscious of the obverse of the proposition, namely, that education should be experience. School work then ceases to be a preparation for life and becomes life itself. While it must be somewhat simplified, because life itself is too complex and experience unselected too expensive a school, yet the activities of the schoolroom are to be natural ones, as similar as may be to those in which pupils engage every day outside the walls of the school and those in which they will engage when school days are past.

Now it happens that the typical unit of life is the "purposeful act," or, the "project." The project, or undertaking, then, becomes the typical unit of activity in the composition class. Evidently it must be an undertaking in composition, that is, an attempt to accomplish something by means of speaking or writing. The undertaking, too, must be the pupils' own; that is, it must be something which they purpose to do, not something which they carry out under the domination of a superior will. This will be clearer from some examples.

A second-grade teacher in a demonstration school one summer told her pupils of a certain Baby Margaret not many blocks away whose mother was unable to purchase for her the milk which was essential to her well-being. The teacher went on to say that in the winter this milk had been supplied by the pupils of her room but that the funds would be exhausted within the next week. The pupils were at once eager to undertake the provision of the milk supply for the baby. Upon being asked where they would get the money, they suggested a play for which they would charge admission and a lemonade sale. The lemonade sale was undertaken and became the basis of the arithmetic and some other work during the six-weeks' term, but that does not concern us here. With the teacher's consent they began to lay plans for their drama. First they outlined the action, then decided upon scenes, characters, and speeches, and finally carried through the rehearsals, with criticism by those not taking part. Before the end of the term they were able to give their play with considerable success, both financial and artistic. Here was a typical undertaking carried out chiefly by means of language.

Some Interesting Projects Developed

A teacher in an upper grade recounts to her children the success of another group she has known with a lecture-recital, making use of the talking machine. She tells how they have chosen a composer or a certain kind of music and have then found selections illustrating the most important characteristics of this composer or type of music, have assigned these selections for special study to individual members of the class, and have then devoted a period or more to hearing the records with accompanying lecturettes by the pupils who have made special studies. Her pupils invariably decide that this sounds very interesting and that they would like to have similar lecture-recitals. The choosing of the subject and the finding of the selections, while not a matter of routine, does become a matter of course. Here again we have pupils' purposes carried into effect by the use of language as a tool.

On another day the teacher gives as vivid an account as she can of the picturesque origin of tapioca and suggests that there are many other items of our dinner tables which have quite as interesting histories. Perhaps some members of the class suggest certain articles about which they have partial information. After a little talk it is decided that they will study together the sources and processes of manufacture of an ideal dinner. They make out the menu and assign the different items to individuals or committees to look up. After the necessary library work, making of outlines, and perhaps rehearsals in small groups, they carry out a formal program in which the entire process of producing the dinner is set forth.

In similar fashion the teacher tells her own experience of being caught in a shower, or of being surprised, or of learning to skate, and is repaid in kind by pupils eager to tell of their own similar experiences. Or she leaves Red Cross Circular No. ARC 618, Supplement 2, on the table, where seemingly by accident it falls into the hands of some of the leaders among the pupils in her room. As they read how other classes exchange portfolios with groups in distant parts of the United States or in European countries, they begin to ask why their class may not do the same thing. The teacher puts them off until such a question can be asked before the whole group, preferably at composition time. The undertaking is explained by those who have read the little booklet and is adopted by the class. The topics likely to interest the far-away readers are listed on the board, and probably divided among the pupils. Then follows some discussion of the fullness of treatment and the matters of grammar or mechanics concerning which the writers need to be most careful in this composition which is to represent their school abroad. When each has done his best, his product is criticised at least by two or three of his neighbors, probably by the whole group—criticised, not in a fault finding spirit but with genuine intent to make improvement possible. Rewriting is then as natural as breathing.

All these cases differ from the mere learning by doing, as exemplified in the daily theme, in that the pupils are not mechanically carrying out the wishes of someone else but are earnestly, and in many cases eagerly, achieving purposes of their own. Such work includes incidentally the grammar that was formerly taught, and quite as much actual practice in speaking and writing as was ever secured under the drill system, but adds to it the pupil's own intention to accomplish, his own interest in what he is doing, and his alertness to the means whereby he can do it well. In other words, he is living completely. The teacher whose class works in this way is, we say, using the project method.

Steps in the Development of a Project

Let the pupils be genuinely free to form and carry out their own purposes, and it follows, as the day the night, that they will plan together, plan separately, carry out their plans (perhaps with some revisions), and looking back over the whole process, will judge the results. These are just the steps which persons in school or out inevitably take when engaged in any purposeful activity. Whether it be to make a dress, build a house, write a novel, or sell a piece of real estate, from the situation which the individual confronts, he forms a purpose, very frequently formulating it in words. Unless he is very immature, he considers before beginning to act how he may most easily and surely achieve his end. If other persons he knows are engaged in similar undertakings or working with him on his, he is sure to consult with them as to the best means to be employed. Having decided how to proceed, he carries his plans into action. Finally, he looks back over what he has done and decides whether it was worth doing and whether the means he has used were the best possible.

These judgments are not always explicit, and in matters of little moment they are almost unnoticed; but in all attempts in which one is keenly interested there is sure to be a great deal of this evaluating retrospect. If the undertaking has been a failure, why was it? Was the thing impossible to do, or was there some blunder in planning or in executing the plan? If it was a success, there is less talk of the why, but a great deal of re-counting and glorying in the elements which led to success. Now, in the pupils' composition project we shall expect to have, from the situation which confronts them, their formulation of a purpose; their consultation as to the best means of achieving their end; some individual planning for the individual tasks undertaken; the carrying out, through speech or writing, of these plans; and then the judgment of results—all these by the pupils.

Materials for Composition Projects

Materials available for projects in English composition include practically everything which pupils may naturally be led to talk about:

(1) The easiest reservoir to tap is that of personal reminiscence, and so for years we had in our schools narratives from experience. These are very easy to start by means of the teacher's own similar narratives.

(2) Very like them, really made of the same elements, are the narratives from imagination. They are frequently stimulated by means of pictures and conversations leading forward or backward from the situations portrayed. They may sometimes originate as digressions from, or as the supplying of gaps in, historical narratives—for example, as Klapper suggests, the narrative of the mutiny on board Columbus's vessel as related by Columbus, by the mate, or by one of the crew.

(3) Coöperative studies of topics or problems in history, geography, or science make excellent composition projects. In many cases teachers throw together the time allotted to one of these other subjects and that allotted to composition and use the combined period for work in which the special subject furnishes the content and the study of English furnishes the form.

The only drawback in projects of this sort has been the frequent inability of the pupils to find the information which they sought. For this purpose, if for no other, every school should have a strong library, especially of reference books. It is desirable that each pupil consult more than one source of information. It is essential if the audience situation—that is, the feeling of both speaker and audience that the speaker has something to give—is to be maintained, that each pupil or committee must work upon a separate topic. Essentially these are reports. Obviously, the same thing may be done in the provision of backgrounds for the study of literature.

(4) If the school is one in which student enterprises of any social sort—the giving of plays or parties, the securing of school improvements, community service of any kind—is common, the planning of these activities will entail discussions which are very genuine composition projects. These discussions may, it is true, sometimes be so informal as to preclude any group prevision of the expression, but much of the time there may be at least individual prevision of the presentation of the argument which will make use of principles of form already learned.

(5) As the English class becomes in this way the deliberative body of the school, it may also become the clerical force and carry out the correspondence necessary to the various activities in which the class is engaged. There are many more occasions for letter writing than we ordinarily observe and too frequently the teacher meets those occasions which are too urgent to be avoided. In this she burdens herself and deprives the pupils of one of the very best opportunities for education.

(6) Letter writing may be supplemented as an exercise in composition by writing for publication, in a school paper if there is one, in a room paper if there is not. In many cases items at least may be contributed to some local daily or weekly paper. All such writing will prove to be very different from the formal, unnatural essays which we have been accustomed to call themes.

The Plan and the Judgment of Results

As the class group confers concerning its procedure in any composition undertaking, it is likely to consider subject matter first. What needs to be said to persuade somebody? What needs to be found out to inform the class? What elements may be used to entertain the audience? These are the natural first questions. Then follows the division of the task if it is a coöperative study. Just here the pupils may think the plan complete, but this is the teacher's opportunity to suggest that they think how to say it. Whatever principles of form—rhetoric, grammar, or mechanics—they have learned but have not become automatically proficient in, will probably be mentioned by members of the class. In some cases they will foresee problems, such as the pronunciation of French names in a geographical study, or the form in which to tabulate the items of an order letter. This calling to mind the principles of which they should make use in their writing or speaking is exceedingly important in guiding them to successful expression. Five minutes of such consideration is worth an hour's criticism or an hour of a teacher's work in the use of red ink. An error prevented is better than nine corrected.

If such consultation concerning the means of writing or speaking effectively is at all earnest, the teacher will scarcely have to suggest that before anyone proceeds to talk or attempts to write out his speech he ought to make his own individual plan. This means at least an outline, and may very properly include a recall of the comments made upon his last attempt.

The final step is to look back over what has been done and to pass judgment upon it. Sometimes the question, Was it worth while? may be considered explicitly, but always the center of attention is: How far did we succeed and why? The monosyllable why stands for, Why didn't we succeed more completely, and why did we succeed so far as we did? Thus it will bring out both commendable elements of the performance and those which should be discouraged. The mediocre performance gets little attention, as is quite proper. The function of criticism is to encourage and cause to be repeated behavior which is desirable, and to discourage and to prevent the repetition of behavior which is undesirable. Unfortunately, when we speak of it as criticism, we soon fall into the habit of giving whatever censure is necessary and stopping there. This is ineffective in that it fails to establish right habits which are just begun and is frequently deadly in that it breeds discouragement. When criticism becomes judgment of results, it is better balanced and leaves a better taste in the mouth.

The Function of the Teacher

If the pupils are to purpose, the pupils are to plan, the pupils are to carry out, the pupils are to judge their own performance, why should we have a teacher at all? Let us remember that those who act, and especially those who take responsibility for the action, are the ones who are being educated. The ideal, then, is for the teacher to do only that which is necessary, leaving to the pupils as much opportunity for growth as possible. Even so, the teacher will find plenty to do.

In the first place, pupils are not likely spontaneously to originate a sufficient number of worthy purposes. Neither adults nor children purpose except under the stimulation of circumstances, or, as we sometimes call them, "situations." Now the traditional schoolroom is rather bare of effective stimuli. It is almost an intellectual—in some cases a physical also—vacuum, entirely unsuited to excite pupils to the formation of vital purposes. The teacher, therefore, must provide the "situations" which will stimulate the pupils to the purposing necessary to effective learning.

Providing the Situation

The projects cited above illustrate some of the devices by which the teacher stimulates group purposing. They may be stated in more general form as follows: She may tell what some other group has done. She may describe a situation which calls for action. She may arouse her children's curiosity so that each will want information and at the same time be eager to give information to his mates. She may, by telling of some experience of her own or by asking some genuine question, create such a natural social situation as occurs when we meet our friends. These are merely a few suggestions. There are as many ways of arousing pupils to purpose as there are different classes.

Even when the pupils have once made up their minds to a certain undertaking, the teacher will still be necessary to keep them at it and at times to furnish the help without which they would fail. We must remember that our children are, after all, children and that their purposes are not always as constant as is necessary for economy in education. When, because the undertaking is long, or because some other interest tends to pull them away, they falter or even wish to abandon the enterprise, it is the teacher's business to keep them at work. It is best if this can be done by suggestions of the value of the undertaking. When this fails, the pupils' pride may be appealed to, even to the point of some joking advice not to show the white feather or a yellow streak. As a last resort it is better to compel them to carry out that which they have formally undertaken than to allow them to get into the habit of leaving work uncompleted.

Helping Pupils to Keep to the Point

Especially during the planning is there danger that pupils will unintentionally, unconsciously, wander off into the discussion of other matters. Anyone who has ever attended the meeting of an ordinary adult club knows how difficult it is for the chairman to confine discussion to the question before the house. This same difficulty arises in the classroom, and the teacher, as chairman, should see to it that side issues do not entice the pupils from the path toward the goal for which they set out. At times it may be necessary for her to say directly and baldly that someone is talking off the topic, but more usually it will be sufficient for her to raise a question as to what these remarks have to do with the matter in hand; that is, she will help the pupils to find themselves and to see where they got off the track rather than abruptly jerk them back to the place where they ought to be.

Lending a Hand on Knotty Problems

If the enterprises undertaken are sufficiently broad and complex to be really educative, the pupils are unlikely to have sufficient experience and information to carry them through successfully alone. The teacher, because of strong personality, because of more years of experience, because of a wider general knowledge and better acquaintance with the sources of information, should be able to foresee the results of unwise plans which the children propose and to furnish means of overcoming obstacles which are to them insurmountable. Very frequently the teacher must directly furnish information, almost always she must give hints of sources of information, and all the time she must be present as a counselor and coach to guide the feet of her charges away from the pitfalls which would waste their time and bring discouragement. All this she may do without in any sense being a dictator or boss, by merely making suggestions or questioning the advisability of certain plans and by furnishing aid when she is asked for it. From one point of view the teacher becomes a leader among the children, but one of them. From another point of view she may be thought of as a helper who is called upon to do whatever they cannot do for themselves. Her contribution is fairly sure to be larger than that made by any pupil of the class, but her pupils have more opportunities to act and to grow than do those of the teacher who employs traditional procedures.

The Teacher's Rôle in Judging Results

In the judgment of the performances, too, the teacher has a necessary rôle. The pupils, unguided, frequently forget what they are trying to do and need to be recalled to the task in hand. The younger the pupils the less able they are to do genuine teamwork and the more liable they are to fall into personalities and mere fault finding. Such worse than waste of time the teacher must prevent. More than all else she must supplement and rectify their critical judgments.

Ability to discriminate accurately between the helpful and the weakening elements in any composition comes only of training. Often the pupils can tell which of two paragraphs is better and yet cannot at all discover the sources of the effectiveness of the one or the hidden weakness of the other. They may rightly expect the teacher to assist in such cases. The teacher, moreover, may so steer this retrospect and evaluation as to raise new problems of rhetoric, grammar, and mechanics, through the study of which new principles will be learned. Without such steering, progress in the knowledges which underlie skill in composition must be haphazard and uncertain.

Summary of the Project Procedure

Such, then, is the project procedure in composition: Teacher stimulation, pupil purposing, pupil planning, pupil executing, pupil judgment of results—all these with the assistance of the teacher. The plan is economical, inasmuch as it calls out the pupil's whole power. There is no inner conflict between that which he would like to do and that which he feels he must do. Attention is really focused upon the task in hand. If the purpose has been made as definite as it should be, there is also much greater probability of successful performance than by other methods, because the pupil is always conscious of the aim toward which his expression is directed. He doesn't wonder what the teacher wants or what will get a good mark, but is guided by the thought, Will this persuade? Will this entertain? Will this make clear? Because he cares about the end for which he is working, he really takes to heart the comments, both praise and censure, which are passed upon his attempt. This makes criticism genuinely effective. No child engaged in a genuine project will ever throw away a paper carefully criticized by the teacher without looking at anything more than the mark. Because the pupil has been free, he has enjoyed the activity and comes to look upon addressing an audience and upon writing not as unpleasant tasks which he will avoid so soon as his teacher-autocrat is removed, but as enjoyable activities.

Finally, the pupil who has used the principles of form as means of success in attaining his own ends feels that these principles are worth while and that they will probably work in other situations outside the classroom. The majority of eighth-grade pupils and nearly all high-school graduates have learned to speak and to write for their English teacher with reasonable correctness, if not with genuine effectiveness, but their habitual expression elsewhere is far different. If they can be made to realize that the manner of expression which they use in the English class can be profitably employed wherever they go, we may have some hope that our schools can really raise the level of linguistic expression in our country.

The Project Method in History

THE content of the history course in the elementary and junior high school and the methods to be employed depend upon what the purposes of the study of history are understood to be. When we have decided what the outcomes of any educational undertaking are to be, we have gone a long way toward deciding upon both content and method.

What, then, are the purposes of the study of history in the grades below the secondary school?

(1) The understanding and solution of many present day problems depend upon a knowledge of the origin of these problems. How far has the solution of a given problem been carried and how did men meet and solve similar problems in the past? Why is this problem still unsolved, and what are the possible consequences of this or that solution?

(2) Children should be made conscious of the long process of evolution through which our social and governmental ideas have come down to us. They must learn that there are no short cuts to real progress.

(3) History in the schools should foster a feeling of responsibility to conserve, improve, and pass on valuable material and spiritual inheritance which have come down to us from the past.

(4) History should picture for the pupil the toils, privations, and sacrifices of those who have given us our legacy of American institutions, laws, and ideals of government and civic control.

(5) The study of history must teach our children that the rights and privileges of citizenship in a democracy carry with them real duties and responsibilities.

(6) The study of history should train the pupil in the use of books, and in the methods of carrying on investigation. It should train him to suspend judgment, to compare conflicting statements, and to have respect for the opinions of others.

(7) The study of history should develop in the pupil an appreciation of the value of coöperative effort, even that of men and nations far apart in time and place. The pupil should feel himself debtor to a long line of faithful thinkers and workers.

(8) New inventions and new industrial developments call for many complex readjustments. Many such readjustments have been necessary in the past. Pupils should understand that the changes made necessary by inventions have been to the ultimate advantage of mankind, even though the period of readjustment may have been difficult.

(9) The study of history should develop character by calling out the best in the pupil in response to the inspiring examples from the past.

The first duty of the teacher who would employ the project method is to decide upon the experiences which she wishes her pupils to live through. The teacher may then plan projects which will lead toward the desired experiences. While the teacher must have the final outcome of the undertaking in mind from the beginning, she should not make the mistake of always imposing her own projects upon the children. Pupils will engage most heartily in those activities which they feel answer to their present needs most directly.

The use of the project method in history will cause the pupils to work together for the common good; it will teach the value of the division of labor and the pooling of results. These experiences in themselves constitute valuable lessons in democracy. The socialization of the study period, as well as of the recitation period, will be accomplished without the use of any special device.

The following projects may be studied as explanations of present day conditions and events, or they may be used in the course of a more formal development of the subject in the traditional manner. The examples are intended to be suggestive only. A course of study made up of projects which are to be followed slavishly is only a little better than a topical course. The pupils should be lead to discover and organize their own large projects. Carefully guided discussion will soon cause the large, more vague projects to become analyzed into several smaller, more specific projects. When this stage has been reached the class is ready to divide the work of investigation among various groups or individuals of the class.

I. Constructing a Forecast Map of a Presidential Election:

- **A.** What does the Constitution say about the election of the president? Why did not the makers of the Constitution provide for the direct election of the president?
- **B.** Write the number of electoral votes of each state on a blank outline map.
- **C.** How did each state vote in the last three or four presidential elections?
- **D.** What factors may change certain states to another column in this election?
- **E.** Construct a colored forecast map of the United States. Compare this map with the election returns.
- **F.** What is the cause of the "Solid South"?
- **G.** What is the cause of the almost equally solid New England?

II. A Forecast of the President's Message:

What questions will the president probably discuss in his message? What labor and industrial questions? What questions about foreign relations and treaties? What financial matters? What political questions?

III. Would You Favor Giving the President a Term of Six Years?

- **A.** How could this change be made?
- **B.** Does a president ever favor laws because he thinks they will aid his reëlection?
- **C.** Does a president ever make appointments for the same reason?

IV. Amending the Constitution of the United States: If a proposed amendment is before the states, each pupil should color a map showing the progress toward ratification. No other method can make the process, as well as the extreme difficulty, of amending the Constitution so plain.

V. The Constitutional Convention, 1787:

- **A.** Write a report of a supposed conversation between delegates while they were waiting for the convention to open.
- **B.** To make the conversations historically true we must know:
  - **a.** The weaknesses of the Confederation Government.
  - **b.** The conditions of trade between the states.
  - **c.** About states' jealousies and fears.
  - **d.** The fears of the people about federal taxation and power.
  - **e.** The importance of the Northwest Territory.
  - **f.** Lack of respect on the part of foreign powers for the Confederation Government.

VI. Report a Conversation Between a Federalist and an Anti-Federalist About the Ratification of the Constitution:

In order to make the Constitution true to history, it will be necessary to find out what arguments were used for and against ratification. Remember also that in some states ratification was immediate and easily accomplished, in other states delayed and difficult.

VII. Should Immigration to the United States Be Restricted?

- **A.** How many immigrants have entered the United States since 1870?
- **B.** Classify these immigrants as from Northern, Central, or Southern Europe.
- **C.** What are the characteristics of a good citizen?
- **D.** What are the desirable traits of present day immigrants? What traits are undesirable?
- **E.** What economic conditions make restriction of immigration desirable or undesirable at the present time?
- **F.** Why do so many immigrants live in large cities?
- **G.** What are the most important agencies for the Americanization of the foreign born?

VIII. What are the Causes of the Recent Movement of Negroes from the South into Great Industrial Cities of the North?

- **A.** Educational, political, and economic advantages to the negroes? Disadvantages of crowded and insanitary living conditions.
- **B.** New problems of the cities affected.
- **C.** Effect upon the South.
- **D.** Progress of the negro race since emancipation.

IX. In What Ways Does the "New South" Differ from the "Old South"?

- **A.** Differing labor conditions.
- **B.** Industrial development since the Civil War.
- **C.** Effect of the development of a skilled white laboring class.
- **D.** Improved educational advantages.
- **E.** Improved transportation facilities.
- **F.** Changed social conditions.

X. Why Have Many Industries Been Taken from the Home to the Factory?

- **A.** Examples: the making of cloth and clothing, shoes, cheese, butter and soap; the canning of vegetables and fruits; the preservation of meats such as bacon.
- **B.** Effect upon home life.
- **C.** Upon prices.
- **D.** Upon growth of cities.
- **E.** Upon the number of wage workers.
- **F.** Upon the price of articles made.
- **G.** Upon the usefulness of the articles.

XI. How Did the Invention of the Steam Engine, the Cotton Gin, the Power Loom, and the Spinning Jenny, Considered as a Group, Influence Life in America and England?

- **A.** Slavery and slave extension westward.
- **B.** Development of factories in the North and in England.
- **C.** The growth, price, and exportation of cotton.
- **D.** The use of cotton cloth.
- **E.** Present-day labor conditions in the South.
- **F.** The race question.

XII. Is the Rapid Growth of Cities in the United States a Good Thing?

- **A.** Make a graph showing the number of people living in cities of 10,000 and over, according to the census reports from 1850 to the present time.
- **B.** What are some of the causes of this rapid growth of cities in the United States?
- **C.** What new conditions might check this growth of city population?

XIII. How Did the Invention of the Steamboat Help the Development of the Mississippi Valley?

XIV. How Did the Building of the Erie Canal Give New York an Advantage over the Atlantic Ports?

XV. What Has Been the Effect of the Invention of the Reaper?

Think about the development of the West, the possibility of large farms, the price of flour, the number of farm workers required, and the exportation of grain from the United States.

XVI. Was it Right for the United States to Help the Companies Build the Pacific Railroads?

- **A.** Find out what aid was given.
- **B.** Resources opened to use. Value to all the people.
- **C.** Value of the Pacific Railroads to the Pacific Coast states.

XVII. Was the Mexican War Just?

- **A.** Relation between the annexation of Texas and the extension of slavery.

B. How did the payment for the land taken from Mexico affect the question of the justice of the war?

C. Is the region better off today than it would be under Mexican rule?

D. If such valuable states as Texas and California were a part of Mexico today, how might they improve conditions in that country?

XVIII. Why Were There Such Marked Differences Between the Lives of Colonists in Virginia and in Massachusetts?

Think about the kinds of people who settled these colonies, the industries, productions, size of farms, local government, ideas about education, homes and home life, and labor.

XIX. Compare a Kitchen in a Plymouth Colony Home with a Kitchen in a Modern City Home.

XX. If Benjamin Franklin Could Come Back Today, what Inventions and Changes Would Interest Him Most?

Think about his interest in improving life in the cities, his inventions, how he made his living, and his interest in the new government.

XXI. How Does the Building of Good Roads and the Use of Motor Trucks Affect the "Short Hauling" of Goods by the Railroads?

XXII. Why Has It Been Possible for the People of the United States and Canada to Get on Without Forts and Armies Along the Border Between the Two Countries?

XXIII. Should the United States Continue to Control the Philippine Islands?

A. How have we helped these people?

B. Are they contented under our rule?

C. How much self government have we allowed them?

D. Are the Filipinos capable of complete self government?

E. Of what value are the islands to the United States?

F. To what dangers does the control of the islands expose the United States?

XXIV. What Events Have Made the United States a "World Power"?

Think about the effects of the Spanish-American War, the building of the Panama Canal, the World War, and our rapidly growing foreign trade.

XXV. Construct a Colored Map Showing the Territorial Growth of the United States.

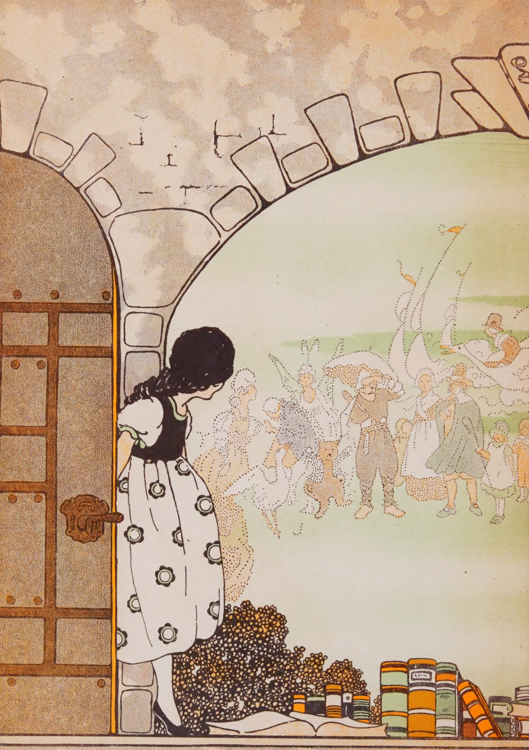
XXVI. In What Respects Were the Revolutionary War and the Civil War Alike? In What Respects Were They Unlike?

A. Was the Revolution a civil war?

B. In what ways had the people of the English colonies and the people of England become different?

C. Were all the people in the colonies in favor of independence?

D. In what ways were the people of the North and South different?



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